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Skeptical Inquirer

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[FROM THE EDITOR

New Anti-Evolution Tactic Doesn't Add Up

Are you continually surprised at the lengths intelligent people will go to rationalize belief systems contrary to good science? Even to common sense? I still am, and I've been involved in science-based skepticism for a very long time. So even if you are a longtime reader of SI, where we repeatedly explore the psychology of why people so strongly hold onto their beliefs, I bet you nevertheless also sometimes get taken aback. New examples emerge virtually every day. From the antics of antivaxxers (anti-mask-mandate truckers blockading bridges for weeks), to the assaulters of the U.S. Capitol stimulated by conspiracy theories and lies about a stolen election, to flat earthers and their increasingly conspiratorial views—and every topic in between—there seems no limit to peoples' determination to defend views that to the rest of us seem ridiculous, even dangerous.

In this issue, Jason Rosenhouse, a professor of mathematics at James Madison University, writes cogently about "The Failures of Mathematical Anti-Evolutionism." *Mathematical* anti-evolutionism? He has been following the topic for years, and he tells us all about it. In fact, he wrote an upcoming book from Cambridge University Press about the subject. If old-earth creationists are more sophisticated than the young-earth variety, and if intelligent-design proponents are more sophisticated than regular creationists, then I suppose those who use mathematics to deny evolution are superficially more sophisticated still.

Rosenhouse gives them careful consideration. He understands and analyzes their arguments. He deciphers their flaws. He shares his conclusions with us, and they don't require any mathematics. Despite proponents' use of theory, math symbols, and Greek letters, he says, "The whole line of reasoning amounts to nothing."

* * *

The great scientist E.O. Wilson has died. He understood, to an almost unparalleled degree, the world of the small (social insects) and the mutual dependencies from one species to the next—and one scale of life to the next—that make up our entire interconnected biosphere. He was a clear and best-selling author, one of the most famous fellows of our Committee for Skeptical Inquiry. In our special memorial section, I briefly chronicle his life and work. We then present moving personal reminiscences and tributes (and some criticisms) from biologists Richard Dawkins and Sean B. Carroll and cognitive scientist Steven Pinker.

* * *

The world has taken a terribly wrong turn. Russia's invasion of Ukraine has brought back memories of World War II. Our emotions are raw: anger, anguish, sorrow, helplessness, empathy, and deep admiration for the brave people of Ukraine. Apart from the brutality and wanton destruction, Vladimir Putin's disinformation and lies to the world and his own people are familiar to skeptics, who recognize nonsense when they see it. But we can take no solace in that. We are a community that values human rights, individual freedom, and reason and rationality. All that, and much more, is in peril.

—Kendrick Frazier

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U.K. 'Needle Spiking' Panic Fuels Fear—and Folklore

Benjamin Radford

For several months in late 2021, a panic swept through the United Kingdom after dozens of people reported having been attacked by needle-wielding criminals in bars and nightclubs.

As Adela Suliman of *The Washington Post* reported on October 23:

> There have been multiple reports of "needle spiking"—which involves an injection being administered to someone without their knowledge or consent, usually in a nightclub or bar setting. … Zara Owen, a 19-year-old student in Nottingham, central England, said she woke up after clubbing with a "sharp, agonizing pain in my leg" and "almost zero recollection" of the night before. She walked with a limp for the remainder of the day, she wrote on social media, before finding a "pinprick" and realizing that she had been "spiked" by a needle that had pierced through her jeans.

Police in Nottinghamshire reported fifteen such mysterious incidents in the first three weeks of October, sharing common themes: most of the victims were college-age women, and the incidents happened at nightclubs usually in college towns such as Dublin, Exeter, Glasgow, and Birmingham. British tabloids rushed to splash lurid headlines warning the public of the terrifying new threat. The fear was echoed, if in slightly less sensational terms, by mainstream press such as *The New York Times*, which framed the needle attacks as "a new kind of assault" in an October 22 article.

Many people took to social media to warn others about the danger. This is part of a widespread pattern; in recent years, TikTok and Twitter have hosted many viral videos spreading rumors about dangers and threats—particularly targeted at women and children—including assaults, abductions, and school shootings (see, for example, "Social Media Abduction Rumors Go Viral" in the July/August 2021 Skeptical Inquirer, "TikTok Shooting Panic Hoax Goes Viral" at skepticalinquirer.org; and "Zip Tie Abduction Rumors Spread, Lead to Panic and Arrests" in the November/December 2020 SI).

As news and social media swarmed with scary stories, police investigated. Nottinghamshire police said that no other offenses, including sexual assault, were linked to the reports of being injected. Universities across the country condemned the attacks and called for better safety measures, often adding that they had received no reports of it happening on *their* campuses. Nightclubs also encouraged patrons to be aware of their surroundings and immediately report any suspicious behavior. Marches, boycotts, and protests were organized by

public safety advocates demanding the needle jabbers be stopped. Outrage over the needle attacks prompted a public petition demanding that laws be passed to thoroughly search guests who arrive in nightclubs.

Many young women reported feeling unsafe and anxious due to the reports; some said they wore thicker clothing to ward off needles in addition to increasing their vigilance. A profile of the alleged attackers never emerged, though they were widely assumed to be men. Many noted with exasperation the sexist unfairness of victims, mostly women, feeling they have to take such steps to be safe when the real threat was whoever was injecting people with needles. In most of the news and social media reports, the needle spiking concerns were explicitly linked to, and seen as part of, the larger (and widely recognized) problem of drink spiking, in which sedatives are surreptitiously introduced into a person's drink in a bar or club setting, facilitating assault. The incidents were both mysterious and frightening. But who was doing it and why? What drugs were being used? And more important, why was no one being caught or arrested despite increasing numbers of reports?

A Closer Look

While social media universally hyped the story, some journalists took a more measured approach. An October 22 BBC News article was one of the earliest and highest-profile pieces to cast the claims in a skeptical light. Titled "Injection Spiking: How Likely Is It?," the article approached the topic from a medical and logistical point of view. Professor Adam Winstock from the Global Drugs Survey was doubtful that injections were taking place as described:

> Needles have to be inserted with a level of care—and that's when you've got the patient sitting in front of you with skin and no clothes … The idea these things can be randomly given through clothes in a club is just not that likely. Normally you'd have to inject several millilitres—that's half a teaspoon full of drug—into somebody. That hurts, and people notice.

The New York Times article quoted Fiona Measham, professor and chair of criminology at the University of Liverpool, describing the attacks as "not impossible but really unlikely." Experts agreed on two things: that *drink* spiking is an unrelated but real problem and that it was not *impossible* that a few needle attacks had happened—just very unlikely given the nature of the attack and circumstances.

From a toxicology point of view, any drug capable of the effects attributed to the attacks (fainting, loss of control, blackouts, etc.) would need to be administered in large enough quantities to be effective and therefore would be detectable in subsequent blood tests. Yet in all the many dozens of reports, not a single one was confirmed by blood analysis. Despite the combined efforts of several police agencies across the United Kingdom, not one suspected victim of needle spiking had unknown substances in her or his blood. There was, as might be expected among the clubgoing demographic, evidence of other psychotropic drugs, including alcohol, ketamine, LSD, ecstasy, cannabinoids, and methamphetamines. These drugs—either alone or in combination—can induce the symptoms reported in the needle attacks, but no unintentionally ingested drugs were found.

Professor Chris French of Goldsmiths College at the University of London was one of the first prominent skeptics to weigh in on the subject in a December 8 article for *The Skeptic* (U.K.) website, noting:

> The reports of feeling a sharp pain are more likely to be due to, say, insect bites or other mundane causes than to surreptitious injection. There are equally mundane explanations for the discovery of marks on the body, such as bruising. When we have no reason to examine our bodies for evidence of anything out of the ordinary, we fail to notice everyday bumps, bruises, and grazes; when we have motivation to look, we are less likely to overlook such mundane marks. This is a phenomenon we see among groups like those who claim to have been abducted by aliens, where any mark of unknown origin that they find on their bodies is taken as evidence of the medical intervention by extraterrestrials they were already primed to believe occurred.

The needle-spiking panic soon faded as quickly as it came, and though reports dropped quickly, the police continued to investigate. There were few leads to go on, and the lack of motive was yet another confounder. Why would one or more people go to the difficulty and effort of surreptitiously drugging strangers with needles in clubs? There seemed to be no benefit—and, given the increased police presence, severe consequences—to the act.

Panic and Reports Spread

As reported attacks waned in the United Kingdom, they began to appear in the United States. One of the first appeared in connection to an entertainment tragedy. *The New York Post* tabloid reported, "A needle wielding assailant suspected of injecting at least one person with a possible opioid may have sparked the panic that killed at least eight people and injured 300 others during a stampede at rapper Travis Scott's [November 5] concert in Houston, authorities said Saturday." A Slate.com article noted:

> Police and the media floated a bizarre story about a possible culprit. TMZ reported that a mystery assailant wielding a syringe loaded with drugs was injecting people, causing some to unwittingly overdose. Somehow, this alleged assailant is thought to have set off a panic that triggered a stampede among a crowd of over 50,000 people.

Despite news media headlines claiming that police had "confirmed" the needle attack at the Astroworld concert that began with a security guard, Houston Police Chief Troy Finner soon debunked the rumor: "We did locate that security guard. His story is not consis-

tent with that. He says he was struck in his head. He went unconscious. He woke up in the security tent. He says that no one injected drugs in him."

The following month, another alleged needle attack occurred, this one in Manhattan. WABC News reported on December 13 on the incident:

> Two concertgoers were apparently punctured in the buttocks, possibly with a needle, while attending a rap concert at Irving Plaza Sunday night. Police say the victims, a 17-year-old male and 21-year-old woman, were both jabbed while at the Sleepy Hallow concert around 10 p.m. Detectives believed they were both punctured by the same female concertgoer, likely armed with a needle.

The attack was never confirmed, and the woman armed with a needle was never found.

A History of Needle Attacks

Strange as the rash of incidents was, it was not without precedent; reports of, and fears about, needle-wielding strangers are not uncommon. In 1989, for example, dozens of women in New York City claimed to have been attacked with needles while in public. Karen Tumulty of *The Los Angeles Times* reported on Saturday, November 4, 1989:

> Groups of teenage girls have jabbed dozens of Upper West Side women with sharp pointed objects in recent days. … As of Friday, 39 women, ranging in age from 14 to 50, had reported being jabbed since October 24. … The [accused] girls are reported to be black, and all but one of their victims have been white.

This conclusion led to the investigation being treated as a hate crime (though the attackers reportedly said nothing, including racial epithets). Reporting by James McKinley Jr. in the November 1, 1989, *New York Times* added, "In most of the cases, the women were walking alone on the street and felt a pricking from behind as a group of black teenagers passed them."

A police officer reported that "the jabbings happened quickly, with the attackers disappearing almost instantly. In some cases the victims have not even noticed the wounds until later," a feature reported in U.K. nightclubs some thirty years later. Rumors circulated that the needles were infected with HIV, the virus that causes AIDS, and public health officials tried to calm fears by noting that the chances of contracting AIDS from such an assault were very remote. As in the United Kingdom, as fears spread people began wearing heavy clothing to protect themselves from the alleged assaults. Mayor Ed Koch offered a $10,000 reward for information leading to the arrest and conviction of the suspects, though none ever emerged, and the reports soon subsided.

The idea of being attacked by invisible, elusive, and unknown people or entities is understandably terrifying. Social context plays an important role in these panics, and scary rumors reflect social anxieties. In the late 1980s, AIDS was widely feared. Folklore from the 1980s and 1990s often featured rumors of gay men wielding AIDS-infected needles in public places, trying to harm or kill others. The attacks had many of the hallmarks of Fortean phantom attackers (such as by the Mad Gasser of Mattoon and the Monkey Man) and, as noted, even alien abductions.

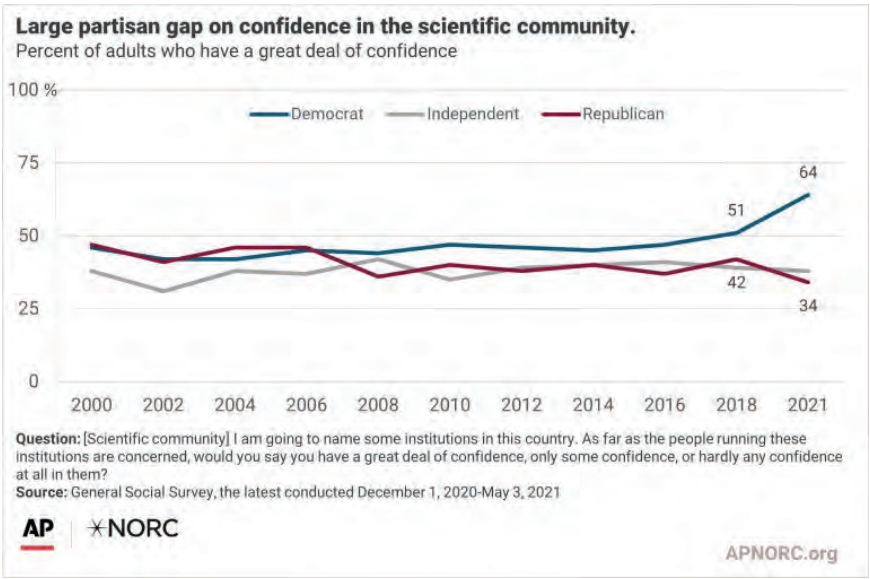
The assumption that the New York City attackers were black was, of course, not a coincidence; it fit preconceived notions of criminality. Similarly, in the United Kingdom, the assumption that the club attackers were male also fit preconceived notions of threat, especially coming soon after two high-profile murders of British women, Sabina Nessa and Sarah Everard—though neither of them were connected to nightclubs or drug injection.

As noted, social media played a large role in spreading the fear, just as it has in other similar scares, including the Blue Whale Game and the Momo Challenge, both of which I've written about in this magazine (see, for example, the May/June 2019 issue). Those rumors turned out to be false yet frightened millions of people. As Prof. French concluded, "If the threat of spiking by injection is indeed imaginary, it is not only causing unnecessary stress and anxiety, especially amongst young women, but it risks diverting attention and resources away from tackling the very real threats of male violence against women that continue to plague society." ■

Benjamin Radford is deputy editor of the SKEPTICAL INQUIRER. His most recent book, *Big—If True*, is based on his "Skeptical Inquiree" column in this magazine.

The Widening Political Polarization over Science

The Editors



It is not just an artifact of media coverage. Political polarization in attitudes toward science has greatly increased.

That is the result found by an analysis issued in late January 2022 of the 2021 General Social Science Survey (GSS) data by the Associated Press-NORC Center for Public Affairs Research at the University of Chicago. The survey was conducted a year into the pandemic and found that confidence in the scientific community increased among Democrats between 2018 and 2021 but fell among Republicans.

It is not just an artifact of media coverage. Political polarization in attitudes toward science has greatly increased.

Overall, 48 percent of Americans have a great deal of confidence in the scientific community. But now there is an astonishing thirty-point gap in confidence between Democrats and Republicans, up from a nine-point gap in 2018. In 2021, 64 percent of Democrats have a great deal of confidence in the scientific community but just 34 percent of Republicans say the same.

A similar gap in trust was observed for confidence in medicine, but the differences were less pronounced.

Democrats have historically had a somewhat greater level of trust in the scientific community, but the data show the polarization increased between 2018 and 2021 as the COVID-19 pandemic emerged and health and vaccine information became increasingly polarized.

The GSS survey also documented a decrease in trust in other institutions such as education and religion. Overall confidence in education dropped from 26 percent in 2018 to 18 percent in 2021, a disturbingly low number. Confidence in organized religion dropped from 21 percent in 2018 to 15 percent in 2021. Republicans' confidence in religion held steady, but confidence in religion by Democrats—and particularly independents—dropped. The 2021 GSS was conducted December 1, 2020, through May 3, 2021, and includes interviews from 4,032 American adults.

There is an astonishing thirty-point gap in confidence in the scientific community between Democrats and Republicans.

"It is definitely a stark change for these particular trends on confidence in scientific leaders and leaders in medicine, to see this degree of polarization," said Jennifer Benz, deputy director of the Associated Press-NORC Center for public Affairs Research.

The Associated Press contacted more than a dozen scientists about the decreasing confidence in science, and the scientists were more concerned than surprised. Marcia McNutt, president of the National Academy of Sciences, noted that scientists and policymakers tend to be cautious and wary of risk—pushing safety, masks, and vaccines—while "Republicans as a group value individual liberty." The data suggest Republicans and Democrats are following the cues of their leaders, said Anthony Leiserowitz, director of the Yale Program on Climate Change Communication.

Science used to be something all Americans would get behind, Rice University historian Douglas Brinkley told the Associated Press. "But we now see it falling prey to the great partisan divide. The world of science should be a meeting house where right and left can agree on data. Instead it's becoming a sharp razor's edge of conflict." ■

Rap, Pop, and Clean Energy: Fighting for Rapid Change in a Slow Congress

Kendrick Frazier

Rep. Sean Casten, D-Illinois, during his Skeptical Inquirer Presents talk on advancing clean energy.

As a scientist and former clean-energy CEO elected to Congress on a protect-our-climate platform, Sean Casten is something of an anomaly in the U.S. House of Representatives. But he has gained the respect of colleagues for his command of energy issues and his willingness to listen.

Casten is a second-term Democrat first elected in 2018 in a formerly Republican stronghold district in the western suburbs of Chicago. He is also a fan of the Center for Inquiry and the Skeptical Inquirer, as he said at the start of his online Skeptical Inquirer Presents webinar on February 17. And he has learned early on that wit and humor can gain attention for needed policy advances.

Casten laughed as he told how he used rap music and pop culture references to get notice in the media for his campaign on behalf of the little-known Federal Energy Regulatory Commission, or FERC, "the most important agency you've never heard of." His rap and use of bad dad jokes and references to Megan Thee Stallion may have made no sense to the "old white guys" (of both parties) on the House floor, but they got notice on TV for his campaign to fulfill a final commissioner position at FERC. "I got on Laura Ingraham of Fox News and *The Daily Show* on the same night," he said, and that got people talking. That advanced the task of adding a commissioner so that FERC could get on with its job of overseeing and incentivizing clean energy for the nation's electrical grid.

Casten took listeners on a quick, lively (really, he does not like to bore) tour of clean-energy issues, the ironies of opposing rules and regulations ("we are fighting each other"), and the hodge-podge of U.S. agencies—not to mention all the states themselves—that do their best to oversee individual aspects of energy policy without much overall planning. We need a national energy policy agency to provide coherence to the whole, he said: "We need to row in the same direction."

Our European counterparts are way ahead of us there, especially in adoption of laws mandating use of clean energy, but the reasons are historical and geographical, as well as political, Casten noted. The United States, Britain, and France all created democracies around the same time, but in Europe it was in the context of a continent already fully populated. In the United States, we could just keep moving west when things got messy or crowded, never really confronting our issues.

FERC was founded in 1935 to help electrify the nation, and it did so well and in a really short time, Casten noted. Now we need it to do the same, substituting clean energy sources for the fossil fuel sources we have long relied on. And it all has to be done in a way that respects those whose jobs and livelihoods will be lost in the necessary transition. We have to look out for them, and the current administration's Build Back Better legislation includes large amounts of money for that. Most important, he said, "We need a world that is not overheating."

Our European counterparts marvel at how we "keep debating the physics" of climate change, but Casten said we no longer have time to do that. We have to replace polluting sources with clean energy very quickly, and, while we "need to be respectful," we no longer have time to argue about the science, which is clear.

But, of course, that is easier said than done.

When Casten was asked if there has been any progress in reducing the partisan divides on this issue, he replied, "There is really a sad answer to that question."

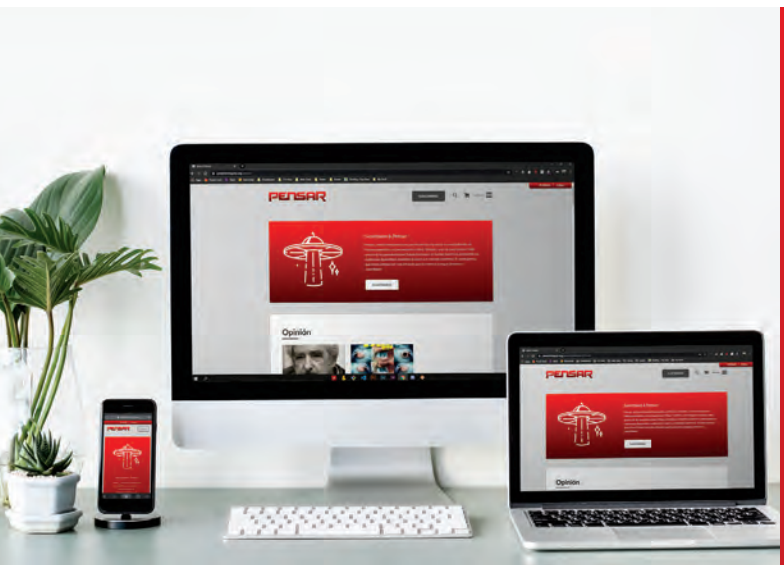
He noted that it was Republican administrations (Ronald Reagan, then George H.W. Bush) that implemented

the Montreal Protocol, the first legislation to protect the atmosphere's ozone layer against chlorofluorocarbons, which was supposed to be the model for future cooperation. But once Bill Clinton was elected, that all changed. When Newt Gingrich became speaker of the house, he and the Republicans decided that if Clinton was for something, they were against it.

It has been that way ever since. "The party has been completely hostile to climate change. … This has led us down this sort of rabbit hole, the fetishization of ignorance."

For thirty years, any Republican who has cared about climate change has been shut out by his own party, Casten said. He knows there are colleagues of his across the aisle who are sympathetic toward climate issues. They say, "I just need the space to prove that you can win an election by being pro-climate. If we can do that for a few cycles."

So, yes, there is some movement, and there are "some crazy deniers there too," Casten acknowledges, but it does no good for him to actively call out their ignorance, which just causes everyone to retreat back into a shell. "I think there are more of them who are aware that they have been on the wrong side of this and don't see a way to get it right." ■



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Zixin Lin, Advocate for Science, Skepticism, and Rationality in China

Zheng Nian et al.

In 2007, Mr. Lin cochaired CFI's International Conference on Scientific Inquiry and Human Well-Being in Beijing.

Zixin Lin, a strong fighter for safeguarding scientific rationality and promoting scientific spirit, died on December 26, 2021, in Beijing at the age of ninety-three. Mr. Lin was a colleague to the Center for Inquiry (CFI), a fellow of the Committee for Skeptical Inquiry, and an honorary chairman of Center for Inquiry China (CFIC).

Born in April 1929 in Fujian province, China, Mr. Lin graduated from the Department of Mathematics of Tsinghua University in 1952. In 1972, he was transferred to the State Scientific and Technological Commission (SSTC) and successively served as deputy director of the Policy Research Office of SSTC, director of the Institute of Scientific and Technical Information of China, and secretary general of SSTC. In September 1985, he became president and founding editor-in-chief of *Science and Technology Daily*, a newspaper of science published each day in Beijing. He had been the honorary chairman of CFIC since 2006.

Mr. Lin was known for his devotion to scientific research and communication in China, with admirable respect for rational inquiry. He was a brave fighter against pseudoscience and supernatural theories. A tenet of his planetary ethics was the belief that scientific and technological progress leads to human well-being. He was one of the early activists in global ecology and environmental protection. Having organized the translation of several leading theoretical works in global ecology, he called for China's public attention to climate change and a green, carbon-friendly lifestyle movement.

In April 1987, Mr. Lin led China's science and technology delegation to visit the Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP) headquarters in Buffalo, New York, and meet with then-chairman Paul Kurtz for deepened communication and dialogues. This trip initiated China's cooperation and partnership with CSICOP. In 1988, Mr. Lin invited Kurtz and an American delegation consisting of six colleagues to visit China, where they conducted academic activities and visits and carried out investigations in Beijing, Xi'an, and Shanghai. The report of those CSICOP investigations during that trip became the cover article for the Summer 1988 Skeptical Inquirer.

Mr. Lin's undeniable efforts in joining Chinese scientists and CSICOP to fight against pseudoscience contributed to science education in China, where conspiracies about superpowers and supernatural phenomena were once prevalent. In October 2007, Mr. Lin cochaired with Kurtz the International Conference on Scientific Inquiry and Human Well-Being in Beijing, cosponsored by CFI and the China Research Institute for Science Popularization (CRISP). It brought the Sino-U.S. cooperation on scientific education to its next phase. (Two reports on that conference became the cover articles for the March/April 2008 SI.)

CFI scholars deeply respect and sentimentally recall Mr. Lin's dedication to knowledge, scientific vision, and sincerity in establishing long-lasting cooperation with international colleagues.

Notably, in 1996, Mr. Lin's presence at the first World Sceptics Conference (WSC) encouraged an increasing number of young Chinese scholars to join the ensuing conferences. Their research reports presented at the WSC, such as *Work of Chinese Sceptics and Anti-Pseudoscience Strategies in China*, *Studies of Supernational Phenomena in China*, and *A Brief History of Parapsychology in China*, allowed international colleagues to learn about skeptical and anti-pseudoscience research in China. Mr. Lin's academic contributions to scientific philosophy, science education and public communication, secular humanism, and scientific ethics will be remembered. We deeply mourn his death with immense gratitude for his unparalleled efforts in pushing China's scientific advancement and international cooperation on the societal level.

We offer our deepest condolences for this science fighter. May he rest in peace. ■

This obituary was prepared by Zheng Nian and colleagues at the China Research Institute for Science Popularization (CRISP) in Beijing, China. Zheng Nian is a professor, research fellow, and deputy director of CRISP as well as the director of CFI China.

GIF Science: The Crisis of Science Simplification on Social Media

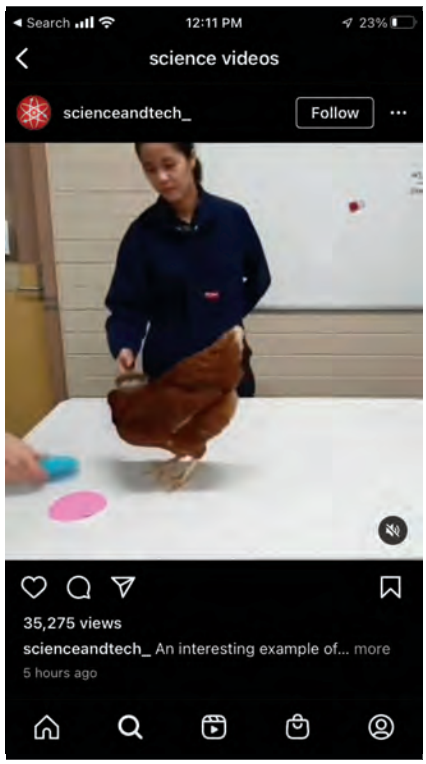
OMAR MERIWANI

Science simplification is considered one of the most useful tools for communicating about science, whether through scientific books, articles, interviews, or documentaries. Depth of the scientific writing employed varies greatly depending on its intended audience. It can range anywhere from educational material for secondary and primary schools, to material appropriate for those pursuing undergraduate degrees, to popular science material written either by scientists aiming to simplify their field by writing books for general audiences or scientific journalists writing for websites and magazines.

Thanks to this wide variety of writing, it is possible for anyone (not just academics) to acquire the latest simplified version of discoveries in advanced scientific fields. Even many academics probably read media that simplify science.

Multimedia technology has grown to produce nearly uncountable forms of media. For example, you can publish content through Facebook posts, tweets on Twitter, and TikTok short views; there are walls, spaces, stories, and many more forms of publishing. Although simplifying science has many advantages, each step of simplification results in the loss of detail. Because many of these multimedia forums are designed specifically to produce super-simplified content for publication, the danger is that they can damage the process of science simplification rather than benefit it.

I'll use the term *GIF science* to denote a type of content that, in the contemporary currency of modern social media (i.e., likes and views), can gain more popularity than a well-written



1,500-word article. Although many traditional authors still prefer the quality of their traditional readers over the likes and views on social media, new generations often don't. Even some traditional media platforms have started to value likes and views in their attempt to modernize. The GIF, or graphics interchange format, is a small, briefly animated image that appeared for the first time in the 1980s but did not become popular until it was used on large social media platforms such as Facebook and Twitter. GIFs are very good for presenting a brief, humorous video. But they are often used to tout "amazing physics" and "the latest inventions," which could be considered the latest form (and the shallowest one) of science simplification—GIF science.

Of course, the simplification crisis cannot be attributed exclusively to GIF images. There are also posts, tweets, and short videos, among other formats, as well as future ones yet to be invented. But while Facebook posts or stories can be used to communicate any form of knowledge or contain links, GIF images cannot be used in the same way. For example, a GIF might show a brief school physics experiment or some natural phenomenon, which would make it possible to use as explanatory material but not as main content.

One may ask, what is the problem? Are we resisting change, or are we jealous of the extraordinary success of newly established Facebook pages? The problem can be explained by the basic concept of simplification. In simplifying science, we are necessarily abandoning many of the details. This makes it easier for more people to provide similar content. There are countless fake research papers, but we can be certain that they cannot gain publicity and a high number of citations within the scientific community because of the difficulty in writing a peer-reviewed research paper and the scholarly standards of the scientific community.

It is possible for Richard Dawkins to write a scientific book for a general audience, but Michael Behe can too. While we know that what Dawkins writes is supported by hundreds or thousands of research papers, the general audience does not know that Behe's writing lacks scientific support.

Therefore, when we simplify, we are opening the door for many others to provide similarly simplistic content. Both scientists and uneducated persons

can tweet. What is worse, GIF science enables publication that can be understood even by illiterates. It may appear innocent when you see an animated image titled "amazing physics" that is liked by 4,500 social media users, but it is not so harmless. I have witnessed many cases of easy-to-digest nonsense published via GIF science. One of the first that comes to mind is the depiction of a train in Japan that supposedly traveled at a speed of 4,000 kilometers per hour, which many people believed was genuine. As harmless as this example of fake information is, many considered another GIF, which depicted imaginary interacting geometrical objects, real as well.

One especially harmful example was a GIF showing sugar levels in grapes being tested with a blood sugar meter. This GIF was used to convince diabetics that it was acceptable to eat as much fruit as they wanted without expecting any rise in blood sugar. While many diabetics are aware that fruits cause an increase in blood sugar levels, many do not know how to use blood sugar meters in an empirical way to fact-check the nonsense in that GIF. In this case, the GIF or the short video made it easy to increase the damage of this misinformation. It was language-agnostic, didn't require any effort to read, and could be watched in a few seconds. It spread like wildfire.

It is a simple observation: As the content becomes simpler, it becomes easier to publish fake information. By monitoring online scientific journals and social media in the Arabic language, I have seen many of those who used to publish real science material being seduced to chasing likes and views; thus they began to publish more GIF science. When academics begin publishing facts in the same manner of those who are uneducated, they give that publishing method legitimacy. Many people may think in this way: "It is acceptable to derive facts from an animated GIF; even doctors use them!" By that logic, if simple posts, tweets, or GIFs receive numerous likes, one may be enticed to publish their own simplified media. Then, the same audience becomes accustomed to seeing super-simplified content gaining legitimacy. By that time, the source of the content does not even matter.

There is an additional effect of GIF science and short videos, such as "amazing physics." Twitter has (hundreds of times) suggested to me some "amazing physics" content (apparently the platform's algorithm classifies this content as scientific, and it's recommending it to me because I am interested in science). This content is accompanied by the sentence, "Teachers who make physics boring are criminals," which I assume was spoken by MIT astrophysicist Walter Lewin—who I was sure did not think of GIF science when he said that. Those who do not know about physics may be led to assume that all aspects of physics can potentially be represented by funny games and experiments.

They may also assume that reading thick books containing equations is a poor way to teach and that a physics teacher should be a clown, but these assumptions are absolutely wrong. Fun in physics can also be found in equations and mathematics, in which the teacher cannot provide much of the usual circus fun. Teachers can do some experiments, but they cannot be David Copperfield all the time. In physics, there are some topics that can be explained wonderfully by spectacular school lab experiments, but that is only a limited part of teaching physics. Physics cannot provide eye candy all the time. Most important, many countries cannot afford laboratories in schools or even provide a decent classroom. Along with "funny physics" and "amazing physics" GIF campaigns, should we expect more physics haters among those who discover real physics in their first year of study? I hope not.

Science is not a holy book that should be kept in a temple. But when we simplify it, we must ensure that we retain its essence and that it foremost provides useful information, with or without entertainment. Some of the new forms of publishing multimedia via social media may not be suitable for the simplification of science or of any form of knowledge. ■

Omar Meriwani is editor in chief of the Real-sciences.com website and magazine, the first scientific skeptic website in the Arabic language. He and colleagues founded the website, which opposes pseudoscience, in Baghdad, Iraq, in 2011. He is a data engineer currently living in the United Kingdom.

[INVESTIGATIVE FILES JOE NICKELL

Joe Nickell, PhD, is CSI's senior research fellow. He is a former Pinkerton detective and author of nearly fifty books.

'Unexplained' Enigmas of World War II

"Unexplained" mysteries are intriguing to read, but compilations of such may exaggerate mystery by omitting facts. It is certainly easier to present some supposed enigma than to try to explain it. Here are three short cases from World War II that readers may enjoy trying to solve, together with my proposed solutions. (One is a poignant case from my own family.)

Premonition of General Mark Clark

At daylight on January 28, 1944, American Lieutenant General Mark Clark—leader of the Fifth Army—climbed aboard a PT boat. With his aide, other army officers, and a war correspondent, Clark rode out on western Italy's Tyrrhenian Sea, along with those on another PT boat. Little did anyone know that something astonishing was about to happen.

Just three days before, a force of British and American men had stormed ashore at the beachhead at Anzio, sixty miles behind a fortified German line running across the country's narrow waist. Now, suddenly, the two PT boats were challenged—not by the enemy's equivalent craft but by an American minesweeper! Urgently, one of the PT skippers ordered the firing of green and yellow flares, using the boat's flasher to send the designated "friendly-craft" signal.

At this moment, General Mark Clark stood up from his customary seat: a stool placed where the boat's bridge shielded it from chilling wind. He would later assert, "Something told me" to get up and head toward the boat's front. Only moments after he stepped away, an artillery shell from the minesweeper hit the wooden stool and blasted it "into kindling" (Yarborough 1994, 187). Crewmen were knocked down, two were killed, and the PT skipper and three others were wounded. Clark picked up the flare pistol and fired a friendly-fire signal, but the minesweeper responded with another shelling.

A wounded crewman quickly turned

the boat around and with the other boat, which escaped injury, retreated back southward. The dead and injured were transferred to another ship, and Clark went with the undamaged PT boat to look for the offending minesweeper. Berating that boat's captain with a megaphone, the skipper cursed him for killing and wounding five men. At this, the repentant minesweeper captain apologized profusely, pleading that "The rays of the early morning sun made it impossible for us to recognize your signals" (Yarborough 1994, 188). Such was the cause of that "friendly-fire" encounter.

Left "unexplained," however, was the astonishing incident of General Clark's alleged premonition. Before you read further, what can we make of the story from a rational perspective?

As discussed in an overview of premonitions I wrote for Skeptical Inquirer magazine, there are various possibilities for "Something told me" narratives. For example, a given case may be due to *retrofitting* (after-the-fact matching). That is, once an event has occurred, details may be interpreted in various ways to better harmonize the prediction (or predictive feeling) with the event (Nickell 2019).

In the case of General Clark, there was a very obvious reason for his having gotten up when he did and heading toward the front of the boat: the *impulse* to see what was happening; after all, he was the man in charge. I submit that that impulse was the "something" that supposedly motivated him to move away from the spot that later proved lethal.

Mystery of a Soldier's Fate

In the run-up to the end of World War II, the Anglo-American expeditionary force invaded the French coast at the beaches of Normandy on "D-Day," June 6, 1944. These were the largest amphibious operations ever to be undertaken. I have a particular interest in that invasion, being the namesake (through my middle name) of PFC Herman Nickell, who became a hero at Normandy. Uncle Herman survived the perilous landing and participated in the heavy fighting around "Purple Heart Hill," as well as in the push toward Saint-Lo, which was captured June 18. Just before that, although slightly wounded, he returned to action and volunteered for a scouting mission. During that reconnaissance, on June 17—near Couvains—he was shot and killed by a German sniper (Nickell 1992). (I was born December 1 of that year and so named after the war hero.)

But was he really killed? It was not until a month later that his parents received a telegram telling them of their son's death in the Allied invasion. A confirming letter arrived soon thereafter. The hometown paper, *The Licking Valley Courier*, stated:

> When the message came Sunday that Herman had been killed in action, a pall of gloom fell upon the entire community. Young people mourned the loss of a noble comrade, and the aged bowed in reverent prayer for the bereaved parents, the lonely sisters, … the precious brother, … and the host of other relatives and friends who are left to mourn his departure. (Quoted in Nickell 1992)

But wait! Confusion soon came. As Herman's brother, J. Wendell Nickell (my father) wrote to U.S. Senator A.B. Chandler in a letter dated September 4, there was a possibility that Herman was still alive. A fellow soldier's letter of June 26 (nine days after Herman's reported death) said that Herman had suffered only a minor wound. Another soldier, in a letter of July 10, reportedly mentioned having seen him just two days previously. And "a picture taken from the *Saturday Evening Post*"—showing wounded soldiers awaiting return to England—included a young man whom family and friends thought was Herman.

"These facts," continued my father's letter to Senator Chandler (a family friend), "are of course indirect, but to a brokenhearted family they are a straw of hope."

Nevertheless, fate decreed otherwise, and the mystery eventually solved itself. Obviously the letter that said Herman had only been slightly wounded was referring to his first wound (whereas the official telegram and confirming letter reported he had been killed in action). The second letter brought confusion over dates or other error, and the magazine photo was a simple case of mistaken identity—likely due to wishful thinking. Such a factor was no doubt involved in countless cases—especially concerning those who went missing in action or perhaps whose remains were just unidentified, like those symbolized at the Tomb of the Unknowns.

Not long after the official letter was received by his parents notifying them of Herman's death, his brother's last letter to him was returned, marked "DECEASED." Still, it was almost three years after the war ended that Herman's body was returned, escorted by a Sergeant Leroy Kinney. The flag-draped coffin lay in state in his parents' home (Nickell 1992). (I, the child who was then under four years old and named for Herman, reportedly sat on Sgt. Kinney's lap. A generation later I wrote a poem titled "As His Namesake." It bears the line "And now I grow old for him.")

Ghost Voice at Sadzot

On December 16, 1944, just five days prior to the legendary Battle of the Bulge, Company B of the U.S. 87th Mortar Battalion was holed up in the hamlet of Sadzot, Belgium (on what would become the northern shoulder of that battle). The men were already veterans of the D-Day assault at Utah Beach. Now, half frozen, they took refuge in the hamlet's old stone and wood houses, anticipating the German spearheads that would come charging toward Liège.

The situation in Sadzot was eerily quiet. While battles raged throughout Belgium, the mortar men had sat on the proverbial powder keg in the hamlet for three days and long nights without the sign of a single German soldier or even the sound of a rifle shot. Where was the supposedly oncoming enemy spearhead?

On December 27, about an hour before midnight, a corporal named John Snyder was hunching over his wireless radio. The set remained "open" at all times, its frequency linked to the infan-

try battalion supported by the eight mortars set up in the hamlet.

Suddenly, a voice on the radio warned: "A large formation of Krauts are headed through the woods directly for your village!"

Snyder alerted the company commander, Captain James J. Marshall, who in turn roused his men. They rushed to take up defensive positions along the front of the hamlet. They waited tensely for some noise to presage the oncoming German attack, but the surrounding pine forests were silent.

After a couple of hours, Captain Marshall canceled the alert, and all but those on outpost duty left to bed down again. Marshall asked the wireless operator who had sounded the alert. He did not know. And the infantry battalion to which the mortar company was linked denied any call from them. But then where had it come from, wondered Marshall. If the caller was from another unit, how could he have known their radio frequency? How did he even know there were Americans at Sadzot or, for that matter, that a German army was heading for that particular village?

Captain Marshall tried other possibilities, contacting the other headquarters in the region. Yet all of them denied giving the warning broadcast.

All remained quiet thereafter—for about an hour. At approximately 1:25 a.m., all hell broke loose. From out of the pines on three sides of Sadzot charged screaming foot soldiers, accompanied by explosions, bursting grenades, and gunfire. The American GIs—sixty-five in all—dashed into battle against some four hundred SS soldiers. Only seventeen GIs were able to get away. The rest were killed or captured, and many of them were wounded. One of the survivors was Captain Jim Marshall, who would ponder ever after: What was the source of the mysterious ghost voice at Sadzot (Breuer [1997] 2016, 148–150)?

(Please do not read further if you would like to try your hand at solving the mystery. Otherwise, I offer my solution as follows.)

I believe the most likely possibility is that the phantom voice was that of a *reconnoiterer*: in military parlance, one sent out to move about and gather information (e.g., concerning military positions). If he was not dispatched by Captain Marshall, perhaps he was from a higher command, or from one of the eight mortar positions at Sadzot, and was sent out by another—or even went out on his own to scout out the enemy. This hypothesis could explain 1) how he knew B Company's radio frequency; 2) how he knew there was a mortar unit in Sadzot; 3) how he knew where the German force was heading; and 4) how—if he was subsequently killed—he never came to light as the source. The hypothesis would also be consistent with the voice's use of the word *Krauts* and answer why "The guy simply came on the air and started talking."

Having so much corroborative evidence favors this explanation being the correct one. And the principle of Occam's razor—that the hypothesis with the fewest assumptions is likely correct—seems to have prevailed again. ■

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[THE PHILOSOPHER'S CORNER MASSIMO PIGLIUCCI

Massimo Pigliucci is the K.D. Irani Professor of Philosophy at the City College of New York and an author, blogger, and podcaster. His academic work is in evolutionary biology, philosophy of science, the nature of pseudoscience, and practical philosophy. His books include *Nonsense on Stilts: How to Tell Science from Bunk* and *Philosophy of Pseudoscience: Reconsidering the Demarcation Problem* (coedited with Maarten Boudry). For more, see http://philosophyasawayoflife.blog/.

On Pigeon Chess and Debating

"Debating creationists on the topic of evolution is rather like trying to play chess with a pigeon—it knocks the pieces over, craps on the board, and flies back to its flock to claim victory."[1]

This famous quote is by Scott D. Weitzenhoffer, who wrote it as an Amazon.com review for Eugenie Scott's book *Evolution vs. Creationism: An Introduction*. It raises an important question: When and how should we debate people who hold to opinions that we consider entirely unscientific and either ideologically or religiously motivated?

When I first encountered the notion of creationism, as a young assistant professor of evolutionary biology at the University of Tennessee in the mid-1990s, I was astounded that there were creationists around so close to the end of the twentieth century. The mythical year 2000 was looming over the horizon. Not only were the much-promised flying cars nowhere to be seen, but now I had to deal with *these* nutcases!

That, of course, tells you just how naive I was at the time. So naive, in fact, that I eagerly volunteered to debate all sorts of strange types passing through campus, from theologian William Lane Craig to Institute for Creation Research associate Duane Gish to preacher-turned-federal convict Kent Hovind. I can readily confirm the correctness of Weitzenhoffer's observation: debating these people really is like playing pigeon chess. So, should we do it?

It depends. The first thing to understand about debates is that your objective is most definitely *not* to change your opponent's mind. Debates are adversarial contests (notice that I referred to the other person as my "opponent"), not amicable conversations. They are more like what lawyers do when they spar in a court of law than a constructive conversation where the common goal is to uncover the truth.

The second thing to keep in mind is that you are also not trying to reach the segment of the audience that has come to cheer on your opponent—at least not in the short term. Those people are ideological partisans, not open-minded spectators. I say in the short term because I know that I have managed to reach some during my debates. They wrote to me years later, telling me that while on the day of the debate they were absolutely certain that I was wrong (and would assuredly go to hell for it), they later realized that I planted some seeds of doubt that eventually germinated and flowered because they were nourished by further exposure to the "heretical" ideas I had advanced.

Then again, let us be frank. Nobody changes their mind about something they really care about upon first exposure to an opposing argument, no matter how convincing the argument and compelling the evidence; I know I don't. We change our minds in a reasoned fashion (as opposed to a sudden conversion resulting from an emotional trauma) slowly, over time, as a result of multiple exposures from multiple sources and at the end of an often-difficult personal journey (Altemeyer and Hunsberger 1997). So, let's not expect miracles here.

If not for your opponent or his supporters, then who are you debating for? Two further segments of the audience: *your* supporters and the uncommitted. Just like the other side needs to feel part of a team and gets excited by the confrontation of their champion with you, your side has similar psychological needs. A good debate is one way to energize people on your side so that they in turn go out and spread the word, contribute financially to the cause, write newspaper op-eds, and so forth. Why do you think evangelical preachers *love* debating heathens?

And then there are the uncommitted, those who have genuinely come to the debate to hear and learn. They might have their own opinion—who doesn't?—but they are not totally committed. And it is your job to reach them. You can see from what I've written so far that you have a delicate task on your hands. You need to connect with two very different kinds of audiences, which accordingly have very different kinds of expectations.

Your supporters want you to pummel your opponent (verbally, of course). They expect zingers from you, a display of knowledge and sarcasm that will make them feel good about being on your team. The undecided, however, are not likely to react well to that sort of rhetorical pyrotechnics. They want to see someone who is calm and knowledgeable, who respects his opponent and takes their arguments seriously. A gentleman (or gentlewoman) and a scholar, so to speak. To strike a balance between these expectations will be tricky, which is why it ain't easy to be an effective debater.

And here is something possibly even more disturbing for a skeptic whose self-image is rooted in the notions of

Logos	Ethos	Pathos
Am I being clear in what I am proposing?	What are my qualifications to speak/write about this?	Am I using a sufficient number of vivid, relatable examples to get my point across?
Is what I'm saying specific enough and not just a bunch of platitudes?	What is my personal connection to the topic at hand?	Remember, anecdotes matter, and they have more of an impact than statistics.
Is my argument well-constructed?	Are my sources credible?	Am I appealing to some values or beliefs that the audience and I share, even though we may disagree on other levels?
Do I have evidence for what I'm saying?	Am I being respectful toward alternative viewpoints, even though I am criticizing them?	Why should my audience care about what I'm saying?
Am I mentioning appropriate sources in support of my argument?	Is my tone appropriate?	
	Is the level of my treatment calibrated for the audience? Or is it too simple or too technical?	
	Is my presentation polished and professional?	

science and objectivity: having good arguments and empirical evidence on our side is nowhere near sufficient to persuade people. We also need to convince the audience that it is worth listening to what we have to say and, perhaps most controversial, we need to connect with the audience on an emotional level.

The guy who first articulated this multi-pronged approach to persuasion was the philosopher who is perhaps most famous for his use of logic: Aristotle. He was also a scientist, having written about physics and having carried out empirical observations in biology. And yet, the book he wrote on rhetoric[2] is still today considered a must-read in the discipline.

Aristotle thought that persuasion requires three components: the logos, the ethos, and the pathos. Logos has to do with getting our facts right and our arguments in proper shape. If we don't do that, we are no better than our opponents, and nothing we say will be worth saying. Ethos is concerned with establishing our credentials, and by that I don't mean just sporting an academic title but convincing an audience that we are trustworthy, that they may gain something from listening to us even if they disagree with the notions we are putting forth. The pathos is about connecting with people's emotions. Why should they *care* about what we say in the first place?

A simple, handy guide to using Aristotle's "rhetorical triangle,"[3] as it is sometimes referred to as, is found in the accompanying chart.

In my experience, scientists and science popularizers pay a lot of attention to the logos, as they should (creationists don't). As far as the ethos is concerned, they seem to think that having a "Dr." in front of their name, or a "PhD" after, is all they need. And they are positively suspicious of the pathos, because they recoil from even the thought of "emotional manipulation."

But human beings are a complex mixture of reason and emotions, and the latter—empirically speaking—are much stronger motivators than the former. When I debated creationists, it became increasingly clear that for most members of the audience, the issue wasn't at all about science, facts, and logic. It was about what they perceived, rightly or not, as a direct threat to their entire way of life, their faith, and their chances of getting into heaven. Being an avowed atheist, I had absolutely no chance of establishing my ethos with them. I quickly decided that my colleague Ken Miller, an excellent biologist and a Christian, was a far better choice when it came to debates with evangelicals, so I redirected my invitations his way.

So, the next time you consider engaging a purveyor of pseudoscience, in whatever setting or medium, go back to Aristotle's rhetorical triangle. It will prove itself a trusted friend. ■

Notes

1. Amazon customer review, https://www.amazon.com/review/R2367M3BJ05M82.

2. Aristotle, Rhetoric, http://classics.mit.edu/Aristotle/rhetoric.html.

3. More on Aristotle's rhetorical triangle here: https://www.lsu.edu/hss/english/files/university_writing_files/item35402.pdf.

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[REALITY IS THE BEST MEDICINE HARRIET HALL

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Misconceptions about Vitamins

In 1747, one of the first controlled clinical trials in the history of medical science involved vitamin C, though the researcher had no idea what a vitamin was; the vitamin wasn't discovered until 1912. Scurvy, a disease caused by vitamin C deficiency, was rampant in the British Royal Navy, disabling and killing more sailors than combat, storms, shipwreck, and all other causes combined. James Lind compared these six proposed remedies:

- a quart of cider a day;
- 25 drops of elixir of vitriol three times a day;
- half a pint of seawater a day;
- a nutmeg-sized paste of garlic, mustard seed, horseradish, balsam of Peru, and gum myrrh three times a day;
- two spoonfuls of vinegar three times a day;
- two oranges and one lemon a day.

The first five proved useless; the last one worked like a charm. Lind's experiment established that scurvy could be cured (and it can also be prevented) by adding fresh citrus fruits to the diet. This eventually led to the nickname "Limeys" for British sailors. It took a long time for the Royal Navy to adopt fresh citrus fruits. One glitch was that they assumed bottled lemon juice would do the trick; they didn't know that the heat used in the bottling process destroyed the vitamin C.

Alas, poor Lind! He didn't understand the significance of his experiment. He continued to believe scurvy was a digestive disease caused by blocked sweat glands.

Fast forward to the present: Vitamins are assumed to be some kind of miraculous panacea. People think they make us healthier, make us live longer, give us more energy, and prevent and reverse disease. Until 1935, food was the only source of vitamins, but today we can get them from pills, dietary supplements, and fortified foods.

How many people take vitamins? A

2019 Harris poll found that 86 percent of American adults take vitamins or supplements (American Osteopathic Association 2019); other estimates are lower but usually over half. Vitamins are commonly added to other supplements and untested alternative health mixtures, adding a veneer of health to unhealthy products. Many people take vitamins, but most of them are taking them for the wrong reasons and due to misunderstandings.

The book *Vitamania: Our Obsessive Quest for Nutritional Perfection* by Catherine Price explains our obsession with vitamins, which she argues are actually making us less healthy. She says, "We are such believers in vitamins' goodness that we don't realize just how much scientists still don't understand about how vitamins work in our bodies, or how much of each we require."

Vitamins Defined

Vitamins are essential nutrients that we must eat because our bodies can't make them. There are other such essential nutrients, such as minerals and some fatty acids, but they are not classified as vitamins. Macronutrients (carbohydrates, fats, and protein) are burned as fuel; vitamins are not. Their role is to facilitate the chemical reactions that keep us alive. Tiny amounts are enough: the recommended amount of vitamin B12 is equivalent to one sixty-seventh the weight of one grain of salt.

There are thirteen vitamins. Four are fat-soluble (A, D, E, and K). Fat is required for their absorption, and they are stored in body fat, where they can accumulate to high levels over time. The other nine are water-soluble: vitamin C and the eight B-complex vitamins. Thiamine is B1, riboflavin is B2, niacin is B3, pantothenic acid is B5, pyridoxine is B6, biotin is B7, folate/folic acid is B9, and cobalamin is B12. (The missing B numbers were for substances that were once thought to be vitamins but turned out not to be.) Water-soluble vitamins are not stored and must be regularly replenished.

Sometimes vitamins are indicated for healthy people: vitamin K at birth, folic acid to prevent neural tube defects in fetuses, and prenatal vitamins. Breast milk is said to be the perfect food for babies, but healthy breast-fed babies require vitamin K at birth and ongoing supplementation with iron, vitamin D, and fluoride. Otherwise, vitamins are not indicated unless you have a vitamin deficiency. If you don't have a documented vitamin deficiency, taking vitamins will do nothing but give you expensive pee. We don't know whether moderate deficiencies have any effect on health. In fact, trying to determine whether an individual has a significant vitamin deficiency is largely a guessing game.

Vitamins come in many different chemical forms. Vitamin B9 occurs as folic acid, dihydrofolate (DHF), tetrahydrofolate (THF), 5, 10-methylenetetrahydrofolate (5, 10-MTHF), and 5-methyltetrahydrofolate (5-MTHF). Try saying that fast ten times in a row! Folic acid is better absorbed than folate. Folate from natural sources is unlikely to cause side effects. Folic acid is synthetic; side effects are uncommon but can include bloating, appetite loss, and nausea.

Vitamin Risks

Many people think vitamins are risk free and assume that if some is good, more will be better. This misconception led to megavitamin therapy and orthomolecular medicine, neither of which is supported by science.

Some people claim that our foods are no longer nutritious due to soil depletion; that's not true (Langer 2020). Some people assume that the more vitamins a food contains, the better it is for you. That isn't necessarily true either: if you add a lot of vitamins to a food that contains water or sugar but no other nutrients (in other words, "empty calories"), it doesn't mean it is a good choice for you.

Linus Pauling was smart enough to win two Nobel Prizes, but he wasn't smart enough to realize he was wrong about vitamin C. He thought it prevented and cured the common cold, but a systematic review has found otherwise

(Hemilä and Chalker 2013). Pauling upped his intake to eighteen grams a day, but that's nine times the tolerable upper limit of two grams a day. Commonly recommended doses of vitamin C are known to cause nausea and diarrhea.

Humans and a few other simians, fruit bats, and guinea pigs are the only mammals that can't make their own vitamin C. Genetic analysis shows that we once had that ability; evolutionary biologists have speculated that losing it probably gave us some kind of evolutionary advantage (Hornung and Biesalski 2019). Various hypotheses have been suggested. I wonder if new technologies of genetic engineering might someday restore our ability to make our own vitamin C.

In the 1990s, cardiologists were recommending vitamin E and folic acid to all their patients, because preliminary research suggested these vitamins would reduce the risk of heart disease. They stopped recommending them when better studies showed those vitamins not only failed to protect the heart, but high-dose vitamin E was linked to a higher risk of heart failure, prostate cancer, and death (Szabo 2018). Oops!

Several Arctic explorers were thought

to have died from vitamin A poisoning after eating polar bear liver, which has the highest level of vitamin A of any animal. That may be a myth; their cause of death has been questioned. However, vitamin A is definitely known to be toxic in large doses.

Health food websites and marketers claim that most of the U.S. population has vitamin deficiency. The website for a company called Biostation claims that number is as high as 92 percent. I can't believe that, because vitamin deficiency diseases have become rare in the developed world. Other questionable sources say everyone should take a multivitamin. I don't agree. I don't think we even know how to diagnose significant deficiencies in individuals.

Deficiency Defined

We read the numbers on food labels and trust them because they are precise numbers that look very scientific. But they don't mean what we think they mean. Recommended Dietary Allowances (RDAs) are not meant to be applied to individuals. They are the amounts estimated to meet the needs of 97–98 percent of the population; many individuals might get by with much less. RDAs have never been established for biotin, pantothenic acid, or vitamin K, and there are no RDAs for infants under the age of one year for *any* vitamin. I bet you didn't know that; I didn't. *Dietary Reference Intake* (DRI) is the general term for a set of reference values used to plan and assess nutrient intakes of healthy people. These values vary by age and sex, activity levels, and other factors.

Estimated Average Requirements (EARs) are lower than RDAs. They are meant to meet the needs of 50 percent of people in an age group. The EAR is the amount of a nutrient that is estimated to meet the requirement for a specific criterion of adequacy of half of the healthy individuals of a specific age, sex, and life stage. As with RDAs, EARs were never meant to be used by individuals to measure the adequacy of their nutrition.

Vitamin levels are fiendishly difficult to measure accurately. They vary from day to day as well as by where they are measured in the body.

We must face reality: the diagnosis of a nutrient deficiency is a very uncertain business. We don't really know how much of each nutrient we need to survive. We have no idea what the optimum amounts are for ideal health. And we certainly don't know the health consequences of a mild deficiency; maybe most of us can tolerate a mild deficiency with no ill effects. If you read a recommendation that "everyone should take this," you will know to disregard it, because the evidence is not clear and we are not all the same.

Who Needs Multivitamins?

The health of people who take a daily multivitamin is not appreciably different from the health of those who don't. Some studies have shown a mild decrease in the risk of cancer; others have not. Some studies have shown that people who take multivitamins don't live as long, but those studies may be flawed.

According to a Harvard website:

> After a review of 26 clinical and cohort studies, the U.S. Preventive Services Task Force concluded there was insufficient evidence to support any benefits of multivitamins or individual vitamins for the primary prevention of cardiovascular disease or cancer among healthy, nutrient-sufficient adults. … A diet that includes plenty of fruits, vegetables, whole grains, good protein sources, and healthful fats should provide most of the nutrients needed for good health. (Harvard T.H. Chan School of Public Health. N.d.)

Taking a daily multivitamin is probably safe and has been recommended as a form of "insurance." I used to think of it as psychotherapy. I worried about whether I was eating right, and a multivitamin gave me an excuse to stop worrying. I soon realized that a faulty diet would be better addressed by improving the diet rather than taking a pill. Food has a vast array of nutrients and supplies fiber and enjoyment not to be found in a pill. Beware of charlatans who offer to give you personalized nutrition advice based on your genome. They can't do that.

In the face of all this uncertainty, what are we to do? I think it's a mistake to succumb to vitamania. Rather than obsessing over our nutrition, we can focus on remembering that food is one of the great pleasures of life, and shared meals facilitate social interactions. I am reassured by two things: 1) vitamin deficiency diseases are very rare in America, occurring only in individuals whose diet is limited, faddish, bizarre, or atypical in some way; and 2) the tiny amounts of vitamins we need can be found in a variety of different foods.

As the author of *Vitamania* said, "The healthiest, most scientific, and most pleasurable way to eat is not that complicated at all." Just eat a wide variety of foods that you enjoy, mostly plants, including plenty of fruits and vegetables, and don't eat too much (avoid becoming overweight). ■

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The Fabulous Land of Punt

We have Queen Hatshepsut, fifth sovereign of the eighteenth dynasty, who reigned in Egypt between 1479 and 1458 BCE, to thank that scholars and travelers have always been fascinated by an elusive place called the Land of Punt.

In fact, the lost land has been mentioned several times over the course of two thousand years of Egyptian history. The first reference is from 2450 BCE in the Pietra di Palermo, an engraved stone tablet that takes its name from the Sicilian city in which it is kept. According to the tablet, the pharaoh Sahura sent an expedition to Punt and returned with 80,000 measures of precious myrrh (used for religious rituals), 23,030 poles of lumber, and 6,000 measures of *electro*, a gold alloy containing about 20 percent silver.

Other later references mention loads of "134 slaves, male and female, 114 … oxen and calves; 305 bulls … ivory, ebony, panther skins … every good thing of that country and the local harvest." Still another mentions the capture of a "dwarf who dances for the god of the spirit land." Perhaps he was a pygmy, captured for his curious stature. The pharaoh was so exalted by the news that he ordered the leader of the expedition to bring the dwarf "alive, prosperous and healthy" and that precautions be taken so that he arrived safe and sound: "My majesty wishes to see this dwarf much more than the gifts of Sinai and Punt." However, none of these sources make it clear where Punt is or how to get there.

It is thanks to Hatshepsut that this forgotten land captured the attention of the first archaeologists who, since then, have not stopped wondering about its location. On the walls of the temple dedicated to the queen, in Deir el-Bahari near Luxor, Egypt, the oldest documented journey beyond the borders of the world is told in the bas-reliefs.

The enterprise, commissioned by Hatshepsut in the ninth year of her reign, involved the use of a fleet of five Egyptian ships, which descended the Red Sea to reach the fabulous land. For a long time, it was believed that the Egyptians were only "river sailors," but as the discovery of one of the queen's large boats at Mersa Gawasis on the shores of the Red Sea shows, it is now clear that they repeatedly pushed along the African coasts.

The ships had a narrow keel, stern, and bow very high above the water and were about twenty-five meters long. There were no decks or cabins, because the hull was designed for the use of rowers on deck. Certainly, there was a hold for supplies and an eight-meter mast driven into the middle of the ship and tied to the keel. A single large sail caught the wind.

In total, the queen's expedition numbered 210 people spread over five ships, including escort soldiers. The bas-relief tells us that the expedition left with a favorable wind. It is not clear the path followed when they left behind "Thebes of a Thousand Gates," located near Luxor. It is unlikely that the squadron went up the Nile, crossed the Strait of Gibraltar, and circumnavigated Africa. It is more likely that at that time there was an ancient waterway, now vanished, that connected the Nile to the Red Sea.

In one of the bas-reliefs, you can see a representation of the Land of Punt once it was reached: there are huts that resemble stilts, with stairs to climb them, date palms and myrrh trees, as well as animals such as a cow, a bird identified by the tail as a Cinnyris Metallica, a turtle, and fish in the water.

In another bas-relief, you can see the gifts brought by the Egyptians to the Prince of Punt: beaded necklaces, bracelets, an axe, and a ceremonial dagger. The prince is accompanied by his wife, who is extraordinarily obese, as the taste in certain parts of Central Africa dictated, and by her daughter. Their skin color is red and their hair black, the same as that of the Egyptians, so it is assumed that they had the same characteristics.

The ruler of Punt gives his gifts to the visitors, and, as explained in the carved inscription, "the ships were loaded with the wonders of the Land of Punt": slaves and spices, incense and myrrh, precious stones and wood, saplings, trunks of ebony, fine leathers, a horse, an elephant, and even peacocks and trained monkeys.

Hatshepsut must have been particularly proud of that expedition (having it immortalized in such detail), but no one had seen fit to reveal exactly where Punt was. After all, the ancients did not travel out of curiosity or adventure but out of necessity, and casually revealing routes to the most precious resources would not have been wise.

So where was the fabulous land? Although precision isn't possible, Punt must have been located south of Egypt, in an area between today's Eritrea and Somalia, because only in that area was it possible to find goods carried by the ships. Somalia, in particular, is the only place in the world where the frankincense shrub is native, in addition to myrrh and other spices and aromas brought back to Egypt. And in Somalia there are animals such as peacocks, monkeys, giraffes, and elephants, while on the mountains there are ebony, precious stones and gold, and all the treasures described in the temple of Hatshepsut.

However, so far no remains of cities identifiable as Punt have been found anywhere, although African archeology is still young. One day it could happen. Until then, it is enough for us to know that Punt must have been so wonderful as to be compared to the embrace of a lover: "When I hold him in my arms, and his arms wrap me," we read in an ancient Egyptian poem, "it's like being in the land of Punt, like having your body impregnated with a perfumed oil." What a land it must have been! ■

[BEHAVIOR & BELIEF STUART VYSE

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Mass Psychogenic Illness: The Unacceptable Diagnosis

Credit: kizzzbeth Pixabay

• In the fall and winter of 2001–2002, school children across the United States began to break out in a strange rash (Talbot 2002). Groups of children—overwhelmingly girls—in Pennsylvania, Oregon, and Virginia turned up with itchy red blotches at school that disappeared when they went home. All this happened in the post-9/11 environment of anthrax scares and worries about terrorist attacks. No toxins were ever found, but eventually the itching stopped and the rashes went away.

• On Christmas Eve in 1021 CE, eighteen people gathered outside a church in the German town of Kölbigk and began to dance wildly, seemingly involuntarily (Waller 2009). They organized in a ring, clapping and chanting, disrupting the mass that was going on inside the church. According to legend, the priest was so enraged that he cursed the dancers to dance for an entire year, which they reportedly did, falling into a deep sleep the following Christmas Day. Some of them never woke up. Soon other dancing outbreaks cropped up throughout Europe, one of which inspired a new dance. A late fifteenth-century outbreak of dancing in Taranto, Italy, was blamed on bites from a local species of spider, and the Tarantella was born (Esterianna and Richard the Poor of Ely n.d.; Waller 2009).

• In 2017, news reports emerged of health problems among workers at the U.S. Embassy in Cuba, including hearing loss and mild traumatic brain injury (Associated Press 2017). Many believed these health problems were caused by a previously unknown sonic weapon employed by the Cubans. President Donald Trump expressed his view that the Cubans were responsible, and the United States responded by ejecting fifteen Cuban diplomats and withdrawing most of its diplomatic staff from Havana (Oppman 2022). In January 2018,

Dancing mania on a pilgrimage to the church at Sint-Jans-Molenbeek, a detail from a 1642 engraving by Hendrick Hondius after a 1564 drawing by Pieter Brueghel the Elder (Wikimedia).

the Senate held a hearing titled "Attacks on U.S. Diplomats in Cuba: Response and Oversight" (United States Senate Committee on Foreign Relations 2018), and in October 2021 President Biden signed the "Havana Act of 2021," otherwise known as the "Helping American Victims Afflicted by Neurological Attacks Act of 2021" (United States Congress 2021).

The Unacceptable Diagnosis

The understandable reaction to the medical problems in the three cases above was to search for an environmental cause—a toxin, poisonous spider bites, or a sonic weapon—that would provide a plausible explanation and, perhaps, someone to blame. In the case of dancing mania, the theology of the European Middle Ages offered a ready solution: possession by demons. But in each of these cases, there is strong evidence that the real cause was psychological rather than medical or supernatural, making the puzzle of responsibility more difficult to solve. For several reasons, this message is not easily absorbed when you are suffering from real physical symptoms. "It's all in your head" is neither a helpful nor an entirely accurate diagnosis.

It used to be called "mass hysteria," but because *hysteria* originally referred to a collection of classical ailments thought to afflict only women, the term has been quite appropriately placed on the ash heap of outmoded psychiatric terms. Today the more common term is *mass psychogenic illness*, which is sometimes contrasted with *somatogenic* illnesses that have physiological origins (Baloh and Bartholomew 2020). But the name change has not made the diagnosis any more palatable, which is a serious problem.

Mind and Body

Under many circumstances, we have no difficulty accepting psychological causes for physical effects. This is particularly true when the effect is positive; meditation, music, and regular exercise can all reduce stress, lower blood pressure, and improve mood (Cleveland Clinic n.d.). In addition, placebos can produce powerful effects. It is estimated that between 65 and 80 percent of the positive effect of serotonin reuptake inhibitors (e.g., Prozac) on depression can be duplicated by administering a placebo, an inert sugar pill that the patient believes contains active ingredients (Kirsch 2000). Expectations are powerful.

Even when the health effects are negative, under some circumstances, the "all in your head" verdict is easier to accept. For example, research suggests that much of the temporary adverse effects people—me included—reported after receiving the COVID-19 vaccines was a *nocebo* effect, a negative placebo-like effect created by the expectation of a bad reaction. A January 2022 meta-analysis found that an average of 35 percent of people in the placebo wings of COVID-19 vaccine trials experienced adverse reactions after the first dose (of a placebo!), with headache and fatigue being the most common symptoms[1] (Haas et al. 2022). In comparison, on average 46 percent of people in the vaccine wings of these studies reported adverse effects. The percentage of people reporting adverse reactions in the placebo groups was significantly lower for the second injection, and fewer people reported bad reactions in the placebo groups than in the vaccine groups. But the authors estimated that 75 percent of the adverse reactions to COVID-19 vaccines could be accounted for by the nocebo effect.

That's a lot of real illness with verifiable symptoms—not to mention missed days of work and lost income—caused by psychological phenomena, and yet as far as I know there has been no widespread outrage or calls for congressional hearings. There are at least two reasons for the difference between the COVID-19 nocebo effects and Havana Syndrome described above. First, the adverse reactions to the coronavirus vaccines are short term. There have been very few reports of sustained adverse

reactions subsequent to vaccination. In contrast, the people suffering from Havana Syndrome report illnesses that have persisted for years in some cases. Second, the people who got vaccinated chose to do so. Most people who received the COVID-19 vaccines went in knowing that there might be a brief adverse reaction, and they factored that into the decision to get vaccinated. Several of my friends scheduled their vaccination appointments so that they could afford to miss work or school for a day or two after. In contrast, the embassy workers in Havana were just minding their own business and did not ask to experience the symptoms they came down with.

Interestingly, mass psychogenic illnesses following vaccinations were common long before COVID-19. One clue that these reports were psychological in origin came from the observation that military recruits sometimes faint while standing in line prior to vaccinations at induction. Infants and toddlers, meanwhile, do not show similar pre- and post-injection reactions. Babies are scared and typically scream and cry when poked with the needle, but even when administered with groups of other infants, they generally do not faint. Loss of consciousness by a baby soon after vaccination—were it to occur—is considered a serious medical event (Clements 2003).

What Exactly Is Mass Psychogenic Illness?

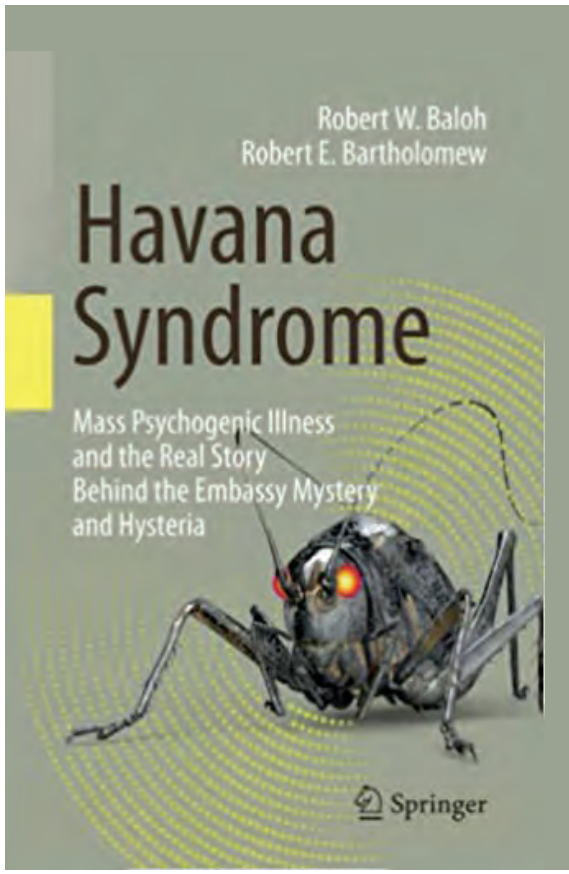
There appears to be no widely agreed-upon definition of mass psychogenic illness, but in 2010, a group of British researchers offered the following five-point definition (Page et al. 2010):

1. Presence of somatic (bodily) symptoms;
2. Pre-existing social connection between two or more of the affected people;
3. An epidemic spread of the symptoms;
4. Attribution of symptoms by patients (or parents/caregivers) to a threatening external agent of a physical or spiritual nature;
5. Symptoms and signs that are not compatible with the environmental explanation offered by victims or with other plausible environmental toxins introduced at the time of onset.

Criteria one through four are often present, but they do not rule out an environmental cause. Often it is criterion five that tips the balance in favor of mass psychogenic illness. For example, the 9/11 rash went away when the students went home—which seemed to implicate the school environment—but the affected students were overwhelmingly girls. Investigators found no plausible explanation for why boys would not be affected by any toxin.

Similarly, in the case of the Havana Syndrome, the "attacks" were presumed first to be caused by acoustic and later by microwave energy (Swanson and Wong 2020), but experts in acoustics and microwave technology suggested it was extremely unlikely that a weapon could produce the kind of brain damage claimed in these cases (Baloh and Bartholomew 2020). Sound has been successfully used as a weapon, but typically it comes in the form of really loud music.

Over a year ago, Robert W. Baloh, a professor of neurology at UCLA, and Robert E. Bartholomew, a medical sociologist and fellow of the Committee for Skeptical Inquiry, wrote *Havana Syndrome: Mass Psychogenic Illness and the Real Story behind the Embassy Mystery and Hysteria* (reviewed in the May/June 2021 SI). Their very thorough analysis reads like a spy thriller and covers both the long history of mass psychogenic illnesses and the specific case of Havana Syndrome. They point out the unlikeliness of the foreign attack hypothesis and suggest that less sinister explanations fit better. For example, early in the Cuban episode, the FBI had an expert on Latin American insects listen to a recording of sounds thought to be associated with the attacks. The expert said the sounds were probably crickets, cicadas, or katydids. The sonic attack theory eventually faded in favor of microwaves (Baloh and Bartholomew 2020), but there is no credible evidence of a microwave weapon either.


Robert W. Baloh
Robert E. Bartholomew
Havana Syndrome
Mass Psychogenic Illness and the Real Story Behind the Embassy Mystery and Hysteria
Springer
Baloh and Bartholomew's *Havana Syndrome* book argues for a far less sinister explanation than foreign attacks.

As might be expected, Baloh and Bartholomew got a lot of pushback on their conclusion that Havana Syndrome was a new example of mass psychogenic illness, but recently their view has begun to receive greater acceptance. In January 2022, the CIA reported that it was "unlikely that a foreign actor, including Russia, is conducting a sustained, worldwide campaign harming U.S. personnel with a weapon or mechanism" (Harris and Ryan 2022). The wording of this statement is quite careful and avoids identifying Havana Syndrome as a psychogenic illness. But it throws water on the dominant weapon theory and leaves the clear implication that the cause could be psychological.

Why Is This So Hard to Accept?

Those who study mass psychogenic illnesses are quick to point out that the people affected are experiencing

real physical symptoms; they are not imagining their complaints. So, why is this explanation so difficult to accept?

First, people often mistakenly believe they are being diagnosed with, and thus stigmatized by, mental illness. This is wrong. The very fact that the symptoms typically start with an index case and spread to larger and larger groups of people suggests it is not a mental illness. Psychological disorders are typically not contagious. The culprit is not inside the people; it stems from the situation the people are in. In many cases, mass psychogenic illness can be understood as a response to a stressful situation. The compulsive dancers of the Middle Ages were dealing with poverty, war, plagues, and famine. The school children with rashes were responding to a uniquely scary period of bioterrorism fears, and the U.S. embassy staff in Havana were posted in a Russian-backed country with whom we have a long history of conflict.

Part of the confusion may simply be language. When we say that mass psychogenic illness is a psychological *phenomenon*, it does not imply that it is a psychological *problem* or mental illness. When a crowd at a sporting event turns ugly and fights break out, the resulting riot is a mass psychological event with dangerous ramifications, but there is no reason to believe the participants are mentally ill. Perfectly normal people do many things together—both good and bad—as a function of group psychology.

Second, once it reaches "epidemic" proportions, people band together, creating an advocacy group in search of someone to blame. The news and social media play important roles in the process. Criterion two above states that "there must be a pre-existing social connection between two or more of the affected people." In the Middle Ages, that meant a direct social connection, and as a result the dancing mania moved relatively slowly through Europe. In today's world, word of an outbreak can move quickly over long distances. The girls in the 9/11 rash case were interviewed on local television, and the news spread rapidly. Similarly, the spy-versus-spy aspect of the Havana Syndrome case spurred considerable media attention. There is a shortage of good research on the role of the media in mass psychogenic illness, but a 2005 preliminary study of past outbreaks suggested that media coverage could facilitate the spread of school-based psychogenic illnesses such as the 9/11 rash case (Vasterman et al. 2005). Media coverage can also build an advocacy group for the victims. When the 9/11 rash hit Quakertown, Pennsylvania, 1,000 parents showed up for a meeting with the school superintendent (Talbot 2002). It's easy to imagine how difficult that meeting must have been for the school officials.

Third, we are no longer in an age—if we ever were—when people passively accept the diagnoses of medical professionals. Rather than leaving the prescribing of medicines up to our doctors, we watch endless drug commercials on television and are urged to "ask your doctor if _____ is right for you." Getting good health services in the United States often requires being very assertive, and almost everyone has a story about having to fight with insurance companies to get coverage. It is not surprising that people would organize and advocate for a preferred diagnosis that implicates some villain rather than the more nuanced explanation of a group psychological effect.

Long COVID-19

The newly emerging diagnosis of long COVID-19 provides another example of the rejection—or neglect—of possible psychological factors. In March 2021, Adam W. Gaffney, a pulmonary critical care physician and assistant professor of medicine at Harvard Medical School, published an article in *STAT* titled, "We Need to Start Thinking More Critically—and Speaking More Cautiously—about long Covid" (Gaffney 2021). Many people have described very disturbing cases of chronic symptoms, including palpitations, headaches, severe fatigue, difficulty sleeping, hair loss, and brain fog that they attribute to the lasting effects of the coronavirus infection. But Gaffney pointed out that there is

no clear definition of long COVID-19 and that some of the people who self-identify as "long haulers" appear never to have been infected with the SARS-CoV-2 virus. In an influential article, science journalist Ed Yong (2021) reported on a survey of long haulers showing that two-thirds of them had negative coronavirus antibody tests, suggesting that they may not ever have been infected. Some of those tests could be false negatives, but Gaffney argued this was a highly unlikely circumstance that undermined the conclusion that COVID-19 was the cause of the symptoms. Without question, people who suffer severe bouts of COVID-19 often have long recovery times (Ekbom et al. 2021), but the large array of symptoms reported by people who had mild or completely asymptomatic cases of COVID-19 suggests that other factors may be involved.

Gaffney did not mention mass psychogenic illness by name, but many of the conditions that encourage psychogenic illness are present in long

COVID-19. The pandemic has been extremely stressful for all of us. A study based on data collected by the U.S. Census Bureau found that in the first months of the pandemic, rates of depression and anxiety tripled in comparison to the previous year (Twenge and Joiner 2020). News about COVID-19 has saturated our lives, and the long COVID-19 phenomenon has received substantial coverage. In addition, today's highly competitive medical services industry has been quick to respond. A recent article in *Becker's Hospital Review* identified sixty-six hospitals in the United States that have opened long COVID-19 clinics (Carbajal and Gleeson 2022). All these factors serve to validate the long COVID-19 diagnosis and encourage the attribution of a wide collection of symptoms to the lasting effects of a coronavirus infection.

As in the Havana Syndrome case, COVID-19 long haulers and their supporters did not react favorably to Gaffney's article. Before commenting was quickly turned off, several long haulers weighed in. A commenter named Rivka wrote, "Throughout history there is always a faction of medical professionals who will take it upon themselves to dismiss a physical illness as 'all in your head.'" To me, Gaffney had shown considerable compassion for the long haulers, writing, "but make no mistake: the suffering described by long Covid patients is debilitating and real." Yet the response to the suggestion that psychology might be part of the explanation was fast and harsh.

Why Does This Matter?

In 2018 and 2019, the *Journal of the American Medical Association* published two MRI studies of U.S. embassy personnel who suffered symptoms attributed to Havana Syndrome. The authors concluded that the scans of the embassy workers' brains showed significant differences when compared to normal controls. As Baloh and Bartholomew (2021) reported, the studies were severely criticized for bias, poor methods, and unjustified conclusions. Nonetheless, media coverage of the studies reinforced the idea that the embassy workers had suffered brain damage.

Unfortunately, if the mass psychogenic illness interpretation is correct, the *JAMA* studies and media coverage suggesting the presence of brain damage may create obstacles to recovery. People who think they have suffered brain injury are likely to assume they will be permanently affected and attribute any symptoms they experience to their damaged brains. In contrast, acceptance of the psychogenic interpretation could facilitate recovery. Baloh and Bartholomew (2020) sum it up well: "The symptoms that began in Cuba as a result of social paranoia and insect sounds exemplify the power of belief. That same power holds the key to their recovery" (188). ■

Note

1. I am just reporting results for "systematic" reactions here. Local adverse effects at the injection site were reported separately and were generally less common.

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[THE PRACTICAL SKEPTIC MICK WEST

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Questioning Joe Rogan

Credit: Spotify / The Joe Rogan Experience

How should skeptics treat Joe Rogan? Should we ignore him? Should we engage with him? Should we write long articles about him? If invited, should we go on his podcast?

I first met Joe Rogan in May 2013. He was filming a TV show called *Joe Rogan Questions Everything*. It was a kind of fringe-science show where Rogan and friends would travel around the country meeting people with unusual beliefs and then having contrasting discussions with experts. Perhaps surprisingly, he played the role of a scientific skeptic, and the show was described at the time as "comedy/reality/debunking."

I say *surprisingly*, because when people in the skeptical community think of Rogan now, they probably think of him as a purveyor of misinformation. He achieved notoriety in 2020 and 2021 for amplifying false, misleading, or controversial claims regarding COVID-19. This came both from the guests on his podcast (the most popular podcast of all time) and his own statements. He has continually expressed suspicion regarding the safety of COVID-19 vaccines and encouraged "young, healthy" people not to get vaccinated (Rogan 2021). After a bout with COVID-19 himself, he took the anti-parasitic medicine ivermectin, which is not indicated for COVID-19 but is popular among anti-vaccine activists and conspiracy theorists.

More recently, the increasing scrutiny on Rogan has unearthed inexcusable remarks from the not-too-distant early days of his podcast. Most egregious were his frequent usages of the N-word, but also many other remarks that come across as racist, insensitive, and sexist. Rogan critics—including, rather bizarrely, conspiracist Alex Jones—have trawled Rogan's extensive back catalog of podcast episodes and created compilations that reflect badly on him.

None of this was apparent to me back in 2013. I'd been approached to appear on the show a few months before filming, and the producer told me that the host was "a celebrity." A few days before the shoot, I was told: "It's Joe Rogan."

I recognized the name but only because I'd watched *Fear Factor*—a stunt challenge game show that he hosted from 2001 to 2006 and from 2011 to 2012. Unbeknownst to me, he was also well known as a former comedic actor, having appeared on *News Radio* in the 1990s, as well as being a successful stand-up comedian and mixed-martial-arts commentator.

The show *Joe Rogan Questions Everything* actually grew out of the popularity of his podcast, the *Joe Rogan Experience*. Rogan has long had an interest in fringe topics, such as Bigfoot, moon landing conspiracies, 9/11 conspiracies, and weird encounters. The TV show was meant to be an extension of this type of discussion and leverage his audience.

I filmed two segments. In one I simply explained the science of contrails, why they persist sometimes behind planes, and why that does not mean they are so-called chemtrails. The second segment was in the workshop of a local pseudoscientist who claimed he could modify the weather with a special device. To show this, he put the device (a "therapeutic" electric field generator with a bit of tape over the label) in a perspex box filled with fog. When he switched it on, the fog moved around.

I poked around, looking for a fan, but it was Rogan who figured it out. "Is it hot?" he asked. I put my hand on the box; it was indeed hot. The fog was simply moving around from rising hot air. The pseudoscientist complained, "It's not *that* hot." Rogan put his hand on the box and replied, "I wouldn't want to put my balls on it." That line made the final edit.

A few weeks after the episode aired, Rogan emailed me, saying he was unhappy with how little time the contrail science had been given on the episode. He invited me on his podcast to give a more detailed explanation. I accepted. Back then (September 2013) he was recording in a small office in Woodland Hills, California, not too far from where I was living. There was another guest, actor/comedian Bryan Callen. Rogan told me we'd go for three hours, which seemed inconceivably long, but it went by very quickly. The conversation was very free-form, almost random. Rogan and Callen riffed about things, we

Jordan Peterson on the Joe Rogan Experience Podcast. Credit: YouTube / PowerfulJRE

looked at YouTube clips, and we talked about chemtrails and other topics. It was fun.

We exchanged a few emails after that. He always came across as polite and thoughtful. Around 2017, the topic of flat earth started getting a little attention, and Rogan invited me back for another episode in May to discuss that. This time it was just me and him. We continued exchanging occasional emails, and I appeared on his show for the third and final time in December 2017.

The Rogan Effect

Rogan has the most popular podcast in the world. Even back in 2013 he was getting 500,000 listeners for each episode of the *Joe Rogan Experience*. When I came back in 2017, it was over a million, and now he has eleven million listeners/viewers *per episode*. A popular or controversial episode can now get over forty million listens/views.

This is huge. To give some perspective, the most popular news discussion shows on cable TV do less than a quarter of those numbers—and often far less. CNN's average audience is only 8 percent the size of Rogan's average audience.

Those massive numbers give him two things: money and influence. The money part was apparent the last time I was on the show. He'd moved the studio from his small Woodland Hills office to a cavernous 11,000-square-foot space with a gym, a bar, and an archery range. The influence came in the publicity boost for his guests. With me this translated to a lot more people following me on Twitter and YouTube in 2017, and then the next year I got a book deal. The publisher had seen me on the *Joe Rogan Experience*, and that was good enough for them. The book and my increased social media audience led to other things: talking-head roles on TV shows, news appearances, and invitations to write op-eds and columns. A portion of my success as a skeptic comes down to Joe Rogan.

Divergence

Unfortunately for my publisher, I was not going to get on the *Joe Rogan Experience* again. In 2017 I did a lot of flat earth debunking, prompted by Rogan's interest in talking about it on the podcast. But by the end of the year, my interests were shifting into something else again, something that would put me at odds with Rogan: I started debunking UFOs.

The years 2017 and 2018 saw the start of a PR campaign by UFO enthusiasts to pressure the Pentagon to disclose what they knew about alien visitors. This was kicked off by a *New York Times* story, "Glowing Auras and Black Money," and accompanied by the release of three grainy videos of UFOs shot by military pilots. I analyzed the videos and suggested some mundane explanations. This heralded a shift in focus of my debunking efforts over the next few years from chemtrails, 9/11, and flat earth to UFOs, coronavirus, and election fraud.

Over the same years, Rogan was also diving back into UFOs but in a far less critical manner than his interest in chemtrails. The guests he invited on his show to discuss UFOs were often strong believers with dubious stories. There was Bob Lazar, who claimed to have worked on reverse-engineering flying saucers. There was Jeremy Corbell, who made all kinds of fallacious claims about a variety of UFO videos. Rogan lapped it up.

Sometimes my name would come up, because I'd become well known for the analysis of the U.S. Navy footage. But Rogan would quickly dismiss me as someone who "just debunks everything" and critiqued my video analysis as being "mental gymnastics." The last time he

emailed me, in 2020, was to send me a video titled "Why Mick West Is Wrong about His Glare Theory on the Gimbal Video."

Dubious Directions

While we were diverging on the topic of UFOs, it was also becoming apparent to me that Rogan was problematic for other reasons. While the bulk of his guests used to be comedians and interesting people, I started to notice he was increasingly giving a platform to people I felt did not deserve one.

He often talked about gender and transgender issues, particularly the problem of transgender athletes—focusing on transgender women in women's sports. It became almost like a bit he would do on his show. I started to notice other people describing him as anti-trans. Jordan Peterson became famous because of Joe Rogan. Peterson was an obscure Canadian academic who had some issues with legislation regarding gender pronouns. He also had a weird sexist theory that appealed mostly to young men—an ideal fit for Rogan's audience. I thought Peterson was ridiculous and said so publicly. Rogan had him as a guest six times, and Peterson's audience grew exponentially.

Rogan gave weight more broadly to what is loosely referred to as the Intellectual Dark Web—a diverse group of commentators and intellectuals who complain about the chilling effects of identity politics and political correctness. People such as Sam Harris, Bret and Eric Weinstein, Ben Shapiro, Jordan Peterson, and others (Weiss 2018).

The Intellectual Dark Web's central thesis is that no conversation should be off limits; they simultaneously rail against restrictions on speech and then attempt to have boundary-pushing discussions. So they talk about race, religion, gender, transgender issues, and more, all in the context of freedom of speech.

The question any outsider has for a member of the Intellectual Dark Web is if they are doing it because of their stated reasons (restrictions on thought and speech are bad) or if they are simply framing it that way to allow their own somewhat racist, sexist, Islamophobic, or transphobic inclinations to surface. That ultimately is the problem with Rogan. He, and his numerous fans, can obviously make the case that he can have hours-long intelligent, thoughtful, even sensitive conversations on these topics (watch his interview with Eddie Izzard, for example). But his focus on certain topics, and his choice of guests naturally makes people suspicious (at the very least) of his underlying motives.

Would I go back on to discuss UFOs? I may be a sucker, but I am ultimately a believer in redemption. Rogan seems to recognize some of his past failings and be willing to apologize and change with some of the issues. He will continue to have guests who promote misinformation, but hopefully now with a little more balance. So yes, I'd probably go back and tell him, and his audience, what I think he got wrong about UFOs—and other things. ■

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[SKEPTICAL INQUIREE BENJAMIN RADFORD

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Duplicating Bigfoot Duplicity

Q: **If the famous Patterson/Gimlin Bigfoot film is fake, as skeptics say, then why hasn't anyone been able to duplicate it?**

—M. Morrow

A: I've heard some version of this question dozens of times during my career as a monster investigator. I have investigated the best photographic evidence for several mysterious creatures—most prominently the 1977 photograph of the lake monster Champ, as seen the articles Joe Nickell and I wrote in the July/August 2003 issue of this magazine and our book *Lake Monster Mysteries*. However, I hadn't yet done an in-depth investigation into the famous 1967 footage taken in Bluff Creek, California, by Roger Patterson and Bob Gimlin.

The Patterson and Gimlin film has been the subject of controversy and debate for half a century and is routinely cited as the gold standard for Bigfoot footage (even some fifty-five years later, which is deeply suspicious given the ubiquity of high-quality smartphone cameras since then). Though the footage is blurry, one thing is clear: it's either a hoax or a Bigfoot. Skeptics have offered damning analyses, both of Patterson and the murky circumstances under which the film was created and developed; see, for example, Greg Long's *The Making of Bigfoot* and Daniel Loxton and Donald Prothero's *Abominable Science*. Bigfoot believers offer a variety of responses, many of which wrongly place the burden of proof on skeptics, such as "If it's a guy in a suit, where is the suit?" and "If it's faked, why can't anyone recreate the film using materials available in 1967?"

The alleged failure of the film to be recreated by researchers has long been a popular talking point among Bigfoot believers. A few examples will suffice. A fellow named Scott Renchin, in replying to a Skeptoid YouTube video about the Patterson and Gimlin film, wrote in January 2022 that "A real skeptic would prove the film is a hoax by recreating the film using techniques and materials used to create the alleged hoax footage. … The BBC did this already and failed miserably." I was also directed to this same BBC show by noted cryptozoologist Ken Gerhard and others.

Film Replication Claims

The literature on this just-under-one-minute film is both voluminous and contentious, and there's a lot to unpack. I'll begin by noting that my focus is neither on Bigfoot's existence

Footage of "Bigfoot" from the 1967 Patterson and Gimlin film

generally nor the authenticity of the film specifically. Over and over when seeking information on this topic, respondents invariably go off topic and dive into why the film is obviously a hoax—or just as obviously authentic. Instead, my topic is very specific and simple: Who, specifically, has actually tried to *replicate the film itself*, using what equipment, and when? What documentation do we have of sincere, dedicated efforts by knowledgeable experts to create footage that matches the Patterson and Gimlin image?

Researchers have tried to recreate the *movement* of the subject in the film. My colleague Dave Daegling, for example, conducted a detailed analysis of the Patterson and Gimlin film in his book *Bigfoot Exposed* and explored the question of whether a human could walk like the creature in the film. He determined that the creature's size and speed are well within human limitations, so it is certainly *possible* for a person to walk the way the film's subject does using what's called a compliant gait. It's not the most comfortable method of locomotion for a human, but it's easy to adopt with a bit of practice. Therefore, the locomotion of the subject doesn't rule out a person in a suit.[1]

Instead, the question is about replication of the *film itself*, which is a far more challenging and expensive task and would require not only the original equipment but a reasonably similar costume, gait, location, environment, and so on.

Where's Bigfoot (Recreations)?

Alleged films trying to replicate the Patterson and Gimlin footage turned out to be nearly as elusive as Bigfoot itself. I found a handful of videos of television shows attempting (usually lightheartedly) to make their own Bigfoot films, while not making any serious attempt to replicate the Patterson and Gimlin film per se. For example, the show *Evening Magazine* described their half-baked, tongue-in-cheek stab at it: "We wondered what it would look like if we tried to make a Bigfoot film of our own. … We picked up a gorilla suit at Champion Party Supply and made no modifications to it. We used a 16 mm film camera, roughly like the one Patterson used" ("Bigfoot or Big-Phoney" 2005).

In questioning Bigfoot proponents, I was often assured that many (or at least "several") attempts had been made

Images from the BBC/Discovery show *The X-Creatures: Shooting The Bigfoot* depicting an actor in a costume for a test shoot analyzing two aspects of the claimed 1967 Patterson and Gimlin Bigfoot film.

to replicate the film. When pressed to name one, the BBC show was prominently mentioned (often accompanied by chiding about how I should do better research). Searching for something more substantive and scientific, I reached out to Daniel Perez, a respected Bigfoot researcher and publisher of the *Bigfoot Times* newsletter, to ask if he was aware of any attempts to replicate the film. He kindly provided a list of references to material about the film (Perez 2022). Of those, about a half dozen were television shows, and of those only two mentioned any replication or recreation. The first was a 2007 Discovery Channel show titled *Best Evidence: Bigfoot*, which Perez notes "covers the attempted replication of the *movements* seen in the [Patterson and Gimlin] film" (emphasis added). As noted, this is not the question at hand, and in any event if anything it casts doubt on the film's authenticity.

The second was to a 1998 BBC show titled *The X-Creatures: Shooting The Bigfoot* (available on YouTube under the title *The X Creatures Bigfoot and Yeti*). Of this episode, Perez notes that "The show attempts to recreate the [Patterson and Gimlin] film but certainly appears to fail miserably." I reviewed the episode a dozen times, and here's exactly how the narrator describes the attempt (at the twenty-minute mark): "Using the same distances recorded at Bluff Creek, the same camera and lens, and an amateur operator, it's possible to *exactly recreate the action* of 1967." The show at no point claims to recreate the Patterson and Gimlin film itself; instead, it's an attempt at recreating the *action* depicted in the film, which is a very different matter. Accident and crime reconstruction analysts recreate *actions* all the time, using anything from toy cars to computer animation. It's a fairly straightforward process that does not require replicating all the relevant conditions at play when an event occurred. Even when an accident or crime is recorded on video, the investigators need not recreate the video itself. They need only to recreate the actions of the people and objects seen in the video.

Costume worn by Maurice Evans as Dr. Zaius in the original film *Planet of the Apes* 1968 (Credit: Mary Harrsch, flickr)

The goal of the *X-Creatures* show was to determine how plausible Patterson and Gimlin's claims are using only two criteria: the reported *distance* and the original camera and *lens*. That's it. The show makes this crystal clear: "The most important revelation … is how close Roger and Bob were to the creature; they were right on top of it, which makes the behavior even less natural. It walked away, utterly unconcerned. … At this distance, with this lens, you're certain to get the creature in the frame—unless you artificially wobble the camera."

There was no attempt at replicating the original film. Nor, for that matter, was there any attempt at duplicating the costume, which would be necessary for recreating the film. We can plainly see that the hair color is wrong, the hair length is wrong, the size is wrong, the musculature is wrong, and the feet they used look nothing like what could possibly have made the tracks allegedly found at the site. The angle to the creature is wrong, the terrain is wrong, and so on.

I still have not found a single film or video attempt at recreating the Patterson and Gimlin film using period equipment, the correct location, a credible costume, and other important criteria. Defenders of the Patterson and Gimlin film can't have it both ways—disingenuously arguing on one hand that this BBC show was the best filmmaking expertise made to replicate the film while smugly noting that it was an obvious failure, because it looks nothing like the original.

With Bigfoot proponents unable to identify a single attempted film recreation, I tried a different approach. I reached out to Craig Scott Lamb, a filmmaker, film historian, and administrator of the Ape Suit Cinema, a Facebook group dedicated to filmed ape costumes. Lamb replied, "I know of no actual attempts by special FX professionals to replicate what was seen in the Patterson film. However, considering the cost of a pro ape suit, I can certainly understand the lack of motivation. … In other words, who's going to foot the bill?"

Lamb's question is as enlightening as his answer: No special effects experts he's aware of have even tried to replicate the Patterson and Gimlin costume—much less in service of a failed attempt to replicate the film itself. He's exactly correct about one of the key impediments to replication—expense—which I'll discuss in my next column. Whether the Patterson and Gimlin film is real or not, the fact that no one has tried to replicate it is irrelevant to its authenticity. ■

Note

1. It was certainly possible to create a realistic costume like that seen in the film in 1967. *Planet of the Apes*, for example, was released the following year, albeit with the help of professional makeup and costumes. Those resources would not have been available to Patterson and Gimlin, though *Planet of the Apes* required close-ups of the actors, including faces in sharp focus, whereas the Patterson and Gimlin footage is at a great distance, out of focus, blurry, and unstable—all factors that (intentionally or otherwise) thwart analysis and facilitate fakery.

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Credit: Harvard University

Following this article, we present three invited comments on E.O. Wilson from CSI Fellows Richard Dawkins, Sean B. Carroll, and Steven Pinker.

E.O. Wilson: A Life in Nature, Citizen of the Biosphere

From ants and butterflies to global biodiversity and planetary survival, E.O. Wilson touted the amazing diversity of life and warned us of how we threaten it. Yet controversy follows him still.

KENDRICK FRAZIER

In what he described as an "accident in a haphazard life," as a child E.O Wilson lost vision in his right eye when a spine from a perchlike pinfish he had caught while fishing jerked out of the water and penetrated his pupil. That injury coupled with a congenital loss of hearing left a teenaged Wilson restricted in his early biological pursuits. He couldn't really hear birdcalls and frog sounds—except for a vague buzzing—so "at this very early age I was destined to become an entomologist, committed to minute crawling and flying insects. … I would thereafter celebrate the little things of the world," the critters he could grasp between his fingers and bring up close for inspection.

This interest had started at the age of nine when his father moved Wilson and his sister from the deep South to Washington, D.C., within walking distance of the National Zoo and a cheap streetcar ride from the National Museum of Natural History. He explored the tiny critters in Rock Creek Park, where "insects were everywhere present in great abundance" and spent hours at the museum, absorbed by the endless variety of plants and animals. He began collecting insects. He acquired a passion for butterflies. He became fascinated with ants. He began to envision a scientific profession, "a conception of science as a desirable life goal."

Those early years also developed in him the idea of "nature as a sanctuary and a realm of boundless adventure." And also a love of wilderness, which became "a dream of privacy, safety, control, and freedom."

Looking back on this time half a century later in his 1994 memoir *Naturalist*, Wilson noted that there is a "lot for those who study the diversity of life to do, a new respectability, and a great responsibility." But he said he had never lost that childhood sense of wonder. "The boy who experienced the magic of the zoo and museum is still strong within me."

* * *

Edward O. Wilson, who died December 26, 2021, at the age of ninety-two, indeed catapulted those childhood experiences in nature into a fabulous career as a brilliant biologist and writer. He was an entomologist who became a world expert on ants and other tiny creatures and a famous life scientist and writer with an overarching vision of the biosphere and its ecosystems as a unified whole. Wilson championed the concepts of sociobiology and biophilia, saw unity in the sciences and humanities, and offered the concept of consilience. He wrote prolifically and lyrically. His first book, *The Theory of Island Biogeography* (1967) with ecologist Robert MacArthur, was widely cited as a seminal work on that topic.

He spent most of his career at Harvard University, where he was Pellegrino University Professor and curator in entomology at the Museum of Comparative Zoology. He was a member of the National Academy of Sciences and a recipient of the National Medal of Science.

He was a lifelong "scientific humanist," unneedful of religion and critical of all dogma but nevertheless willing to engage and unite with religious leaders in dialogue over saving the global environment. He was one of the signers of *The Humanist Manifesto* and a member of the International Academy of Humanism.

In his latter decades and with his voluminous and oft-poetic writings, Wilson tried to educate the world about the dangerous ends toward which humanity is trending. He cautioned those ignorantly and arrogantly extending humanity's destructive power over nature, warning the planet has little left to offer a depleted world and its overcrowded and deprived human inhabitants.

A private and gentle man—courtly some would say—he nevertheless found himself embroiled in numerous public controversies, as when his 1975 book *Sociobiology* created a furor in academic circles. It became much misconstrued by those who fear that if human behavior is shaped partly by genetic forces (and how can it not be?), it is somehow immune to improvement by environmental influences—the social world around us. Some suggested, perhaps correctly, that he had strayed out of his field. But he saw humans as contiguous with the rest of the animal world and realized that humans and their behavior are also shaped by evolution and natural selection.

In *Naturalist*, Wilson wrote two chapters about the matter, "Attaining Sociobiology" and "The Sociobiology Controversy." They provide his personal lively account of having water poured over him by protestors at the 1978 American Association for the Advancement of Science (AAAS) meeting. (Following this article, read Richard Dawkins's own eyewitness account of that lamentable event.) But, more important, Wilson also gives the background of the science of sociobiology. It was new back then, but its main precepts, if not the term itself, are more or less accepted today. And he candidly described the motivations of his detractors at the time, including his department chairman and other colleagues at Harvard, who were strongly influenced by their Marxist and New Left leanings. He admits to being naive at the time about these ideological beliefs, prevalent at Harvard and elsewhere in academia then (and somewhat still). Then he rethought his own evidence and logic.

"What I had said was defensible as science. The attack on it was political, not evidential." The group of academics who attacked him, who had joined with the "radical activists" in the Science for the People group who protested at AAAS meetings, "had no interest in the subject beyond discrediting it. They appeared to understand very little of its real substance" (*Naturalist*, 339).

Controversy has even chased him in the weeks since his death. Some critics turned up evidence for what they see as support for racist views. It was an echo of the old controversy over sociobiology, but they had new documentation for Wilson's support for the controversial Canadian psychologist and academic J. Philippe Rushton (who researched race and IQ)—not just on the grounds of academic freedom but in defending Rushton's science. Nathan Lents, a City University of New York professor of biology and CSI fellow, felt so strongly about the new revelations about Wilson that he declined to contribute to this memorial section. When evolutionary biologist and author Jerry Coyne learned of these new accusations, based on folders a husband-wife team of scholars recently found in the Library of Congress, he blogged (on February 4), "In the end, what do I think of Wilson after these new revelations, which are definitely not a hit job? I think less of him as a person. While he was an excellent scientist in nearly every way, he was wrong in the case of Rushton. He was wrong (and foolish) to support Rushton's ideas."

Of course, Wilson is no longer here to respond to the accusations.

* * *

I regrettably never met Wilson, although as editor of Skeptical Inquirer I had some rudimentary correspondence with him. He was a Committee for Skeptical Inquiry fellow, certainly one of our most prominent, but we never had him at a Committee for the Scientific Investigation of Claims of the Paranormal (CSICOP) or Committee for Skeptical Inquiry (CSI) conference and never honored his prodigious contributions to science and literature.

Richard Dawkins has lamented that no scientist, even those with immense literary gifts (he named Peter Medawar and Jacob Bronowski among others), has ever been awarded the Nobel Prize for Literature. That is true, but E.O. Wilson may be unique among scientists for having won not just one Pulitzer Prize (Carl Sagan did that for *The Dragons of Eden*) but two. His 1978 book *On Human Nature* won the 1979 Pulitzer Prize for general nonfiction, and his massive 1990 work *The Ants* (my copy of this beautiful, large-format, 732-page tome weighs nearly six pounds), with Harvard colleague Bert Hölldobler as lead author, won the same prize in 1991. "The

neglect of ants in science and natural history is a shortcoming that should be remedied," they said in that book's first chapter, while confessing that they wrote the book to "celebrate a personal muse." Ants, they said, "represent the culmination of insect evolution."

I *was* in the same room with Wilson at least once, at the Smithsonian Institution's epic "Man and Beast" symposium in 1969. (My wife helped Smithsonian anthropologist Wilton Dillon organize it.) There he delivered a paper on competitive and aggressive behavior in animals and man. Fortunately, we don't have to rely on memory; it appears in the 1971 book of the symposium, *Man and Beast: Comparative Social Behavior*, edited by J.F. Eisenberg and W. Dillon, Smithsonian Press), and it anticipates some of the themes that marked Wilson's future books.

He began by noting the recent public ascension of animal behaviorists, suggesting that their discoveries may seem to offer some comfort and assurance to humanity:

> It is, after all, comforting to think that our sins are only animal sins. … And that we are no more than naked apes momentarily disoriented in our jerry-built civilization. We want to believe that the beastliness in human nature is beastliness in the primordial sense and not some dark angelic flaw, to trust that we have not escaped so far from our ancestral genes as to be due for an early extinction.

Toward the end, he summarizes:

> From my own point of view as a biologist, the task now before anthropology seems almost overwhelming. Anthropology must encompass human genetics, extending that science to generate a new discipline, anthropological genetics, the study of the heredity of the behavioral traits that affect culture. Only by this means can a measure be taken of heritability and evolutionary potential of the basic personality and behavioral traits.

He concluded, "Competition is widespread but not universal in animal species. Current ecological theory predicts that there are several easily obtained conditions under which competition could be permanently avoided." He said it may be true that man's immediate ancestors, the primitive *Hominidae*, were territorial and very aggressive, but he cautioned that studies of primate sociology are "wholly inconclusive" on this point.

Finally, he added: "I can only repeat my generalization: theory predicts that competition is not an essential property of species, and data from empirical studies show that competition is in fact very far from being universal." In his subsequent books *Sociobiology* and *On Human Nature* (1979), Wilson expanded on these and other themes.

In 2019, on the occasion of the fortieth anniversary of Wilson's *On Human Nature*, Paul Brown revisited the book in the pages of the Skeptical Inquirer (May/June 2019). Even after all this time, he said, the book "is still brimming with ideas and insights about who we are, how we got here, and how to get wherever we want to go." Calling Wilson "one of the most storied scientists of the past hundred years," he noted that the book, even four decades later, remains "a touchstone in the debate about whether human nature is innate, and therefore universal, or imprinted, and therefore necessarily local in space and time. Spoiler alert! *On Human Nature* argues that it is both." But the book goes on to argue that evolutionary biology at least constrains, as Brown phrased it, "the many forms, often bizarre and sometimes not particularly beautiful, that human cultures take on."

Wilson's 1998 book *Consilience* addressed his lifetime

Books by E.O. Wilson

Some of his major works include:

Half-Earth
The Meaning of Human Existence
Letters to a Young Scientist
The Social Conquest of Earth
Nature Revealed
Biological Diversity
Consilience
In Search of Nature
Naturalist
The Diversity of Life
The Ants (with B. Hölldobler)
Biophilia
On Human Nature
Sociobiology
The Insect Societies
The Theory of Island Biogeography (with R.H. MacArthur)

"dream of unified learning." He argued for the "fundamental unity of all knowledge" and the search for consilience, the idea that everything in the world is organized by a small number of physical laws that underly every branch of learning. It drew upon Wilson's optimistic vision that an emerging unity of knowledge would help us rise out of outdated irrationalities and selfish short-term thinking.

"I would like to share his enthusiasm," reviewer Robert M. May wrote in *Scientific American* (June 1998), "but I cannot." May feared that the inflexibility of social institutions will continue to emphasize short-term individual self-interests.

Philosopher and CSICOP founder Paul Kurtz reviewed *Consilience* in a long and thoughtful piece for the Skeptical Inquirer (July/August 1998). He called it a "bold and provocative book" and said it outlined two tasks, one reasonable, the other more difficult. The first was to defend the sciences against the forces that would undermine their integrity, to integrate knowledge across disciplines, and to apply this knowledge for human betterment. This first task, Kurtz suggested, "is eminently reasonable."

What would be "far more difficult to achieve," Kurtz said, was Wilson's goal to unify all knowledge. He noted that Wilson was rare among scientists, most of whom must focus solely on their specialties, because he not only was a world-class specialist on ants and social insects, "but he displays encyclopedic knowledge and consummate literary skills" that brought him two Pulitzers "and enable[d] him to write for a wider public outside his own specialty." He called Wilson's goal of unity "valiant" and "insightful" but added, "Many of his claims need further skeptical scrutiny. Some skeptics will no doubt reject many of Wilson's speculations as unwarranted." Kurtz wrote, "In my view, we should not ignore the efforts of scientists such as Wilson to seek comprehensive explanations of the universe." He noted that this is easier within the scientific world than in the "literary, aesthetic, philosophical, or theological" worlds, because scientific theories can be tested.

Ten years later, philosopher/biologist and CSI Fellow Massimo Pigliucci addressed Wilson's views about consilience with both sympathy and skepticism (SI, March/April 2008). What worried him was that Wilson's view of unifying human knowledge into one broad vision would be achieved "not by a dialogue between the sciences and the humanities but rather by the absorption and reduction of the latter by the former." Whether or not Wilson really thought of it that way, the concern undoubtedly has some merit.

In his later decades, Wilson concentrated more on the world's stunning loss of biodiversity and the consequences we all face as a result. He became our moral conscience in protecting the planet, whether we listened or not. His 2016 book *Half-Earth* is eloquent in that regard. Let's hear some of it in his own words:

> What is man? Storyteller, mythmaker, and destroyer of the living world. Thinking with a gabble of reason, emotion, and religion. Lucky accident of primate evolution during the late Pleistocene. Mind of the biosphere. Magnificent in imaginative power and exploratory drive, yet yearning to be more master than steward of a declining planet.

Credit: Jim Harrison / Wikipedia

Our moral reasoning is conflicted and shaky, Wilson wrote, and not up to the needs of the modern world:

> Like it or not, we remain a biological species in a biological world, wondrously well adapted to the peculiar conditions of the planet's former living environment, albeit tragically not this environment or the one we are creating. In body and soul we are children of the Holocene, the epoch the created us, yet far from well adapted to its successor, the Anthropocene.

The book is a lovely and tragically sad evocation of what we have unwittingly done to the natural world we are a part of. "We should forever bear in mind that the beautiful world our species inherited took the biosphere 3.8 billion years to build," he writes (*Half-Earth*, 211). "Like it or not, and prepared or not, we are the mind and stewards of the living world. Our own ultimate future depends on that understanding."

He tried to end on a hopeful note: "I believe we've learned enough to adopt a transcendent moral precept concerning the rest of life. It is simple and easy to say: Do no further harm to the biosphere." ■

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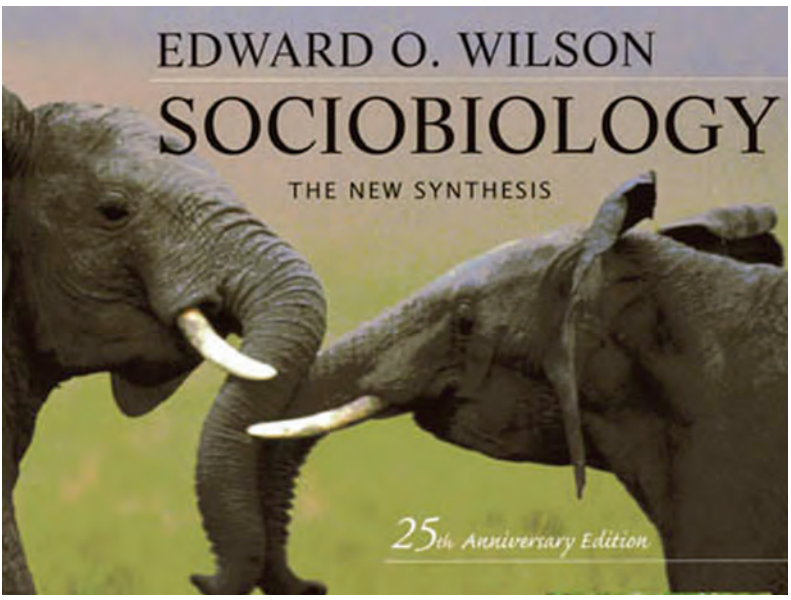
Three Tributes to E.O. Wilson: Was He Our Modern-Day Darwin?

We invited three prominent scientists, all CSI fellows, to give readers their own personal perspectives on E.O. Wilson.

Richard Dawkins

E.O. Wilson's *Sociobiology* was published around the same time as my *The Selfish Gene*, and I came in for a bit of backlash from the wave of misconceived controversy that enveloped Wilson. It had been stirred up by two of his Harvard University colleagues followed by a flock of sheep-like comrades and fellow travelers. It was around that time that I first met Ed Wilson, at the 1978 Washington, D.C, meeting of the American Association for the Advancement of Science. A broadly smiling Wilson limped up to me at coffee time on crutches (he had broken his leg) and, without introducing himself, made a friendly joke about "not wanting any of this reductionism around here"—a genial allusion to our both being accused of the heinous sin of reductionism (whatever that might mean; its critics never seem to make up their minds).

At the same conference, Wilson was on a panel together with Stephen Jay Gould, David Barash, and others. I witnessed the Marxist-inspired rabble as they rushed the platform chanting their puerile doggerel: "Wilson, Wilson, you can't hide. We charge you with genocide." A bearded man tipped water over Wilson, and somebody else threw a cup of water, which was parried by Barash. There was uproar, during which Gould seized the microphone and aptly quoted Lenin in condemnation of "this infantile disorder." The session chairman took the microphone from Gould and said that, as an anthropologist and a Marxist, he wanted to "*personally* apologize to Professor Wilson."



Wilson dried himself off, cleaned his glasses, and then, unruffled and with characteristic good humor, gave a brilliant lecture. In the question time, I was impressed by his magisterial command of the anthropology literature, in a field far from his primary expertise in entomology. One young woman was almost in tears as she asked her question, having apparently been misled into thinking that Wilson's ideas, if right, would condemn her to a life of stereotyped womanhood, imprisoned in the apron of domesticity. Wilson calmly dispelled this all-too-common style of misunderstanding, and she sat down, I hope satisfied.

Equally misguided, and actually downright slander, was the chant of "We charge you with genocide." *What?* Did we hear right? *Genocide?* It is as though these people thought that any mention of the dread word *gene* in the same sentence as human behavior or human psychology automatically branded the speaker a genocidal racist. What superlatives remain, one wonders, to describe genuine racism when it comes along, let alone genocide?

Four decades on, the infantile disorder had died a natural death as its perpetrators grew up. But alas, a muddled re-hash of it resurfaced after Wilson's death in—of all places—*Scientific American*. No water thrown this time, just nasty, snide innuendo backed up by literally no evidence—indeed no indication that its author had read a word of *Sociobiology*. The editor of *Scientific American* went on record as finding the article "intriguing." Have the standards of that once respected journal really sunk so low? Has it abandoned science?

Edward O. Wilson was a gentleman—a humane, humanist gentleman. He was also human, capable of being wrong, as we all are. I believe he was profoundly wrong in his latter-day disagreement with virtually everyone else in the field over kin selection and inclusive fitness (a purely scientific disagreement having no connection with the political pre-occupations of the Washington water-throwers or the wetly incoherent *Scientific American* author). It would be hypocritical of me not to acknowledge the existence of my highly critical review of *The Social Conquest of Earth*, which explains the nature of the disagreement. I stand by it and do not regret its outspoken tone (it is reprinted in my 2021 book *Books Do Furnish a Life*). But I also stand by my profound admiration for Professor Wilson and his life work.

Edward O. Wilson was a biologist of immense distinction.

In addition to his unmatched expertise in the fascinatingly alien world of ants, he was one of the world's leading ecologists. Together with Robert MacArthur, he invented the modern science of island biogeography. If he didn't invent biophilia and consilience, his name will remain linked with those noble philosophies as their most articulate advocate. He was an astonishingly prolific and hard-working author. Having finished a book as substantial as *The Insect Societies*, one might have expected him to take a well-earned rest. Comfortable laurels would have beckoned to a lesser man. But no: "Because … there was some momentum left from writing *The Insect Societies*, I decided to learn enough about vertebrates to attempt a general synthesis." The result was *Sociobiology*. Some momentum! And even *Sociobiology*, which might be thought sufficiently *magnum* for any normal lifetime, is dwarfed by *The Ants*, his later opus written jointly with Bert Hölldobler.

Not many scientists can boast two Pulitzer Prizes. Even more distinguished, he won the Crafoord Prize of the Royal Swedish Academy of Sciences, widely regarded as the equivalent of the Nobel Prize for disciplines "chosen so as to complement those for which the Nobel Prizes are awarded."

A great scientist and a great man.

Sean B. Carroll

The moment I heard of Edward O. Wilson's passing in December, a Paul Simon lyric popped immediately into my head: "Who'll be my role model now that my role model is gone, gone?"

Legions of biologists lost a great role model—not just a brilliant scientist, a gifted writer and storyteller, and a passionate conservationist, but a gentle soul with a deep love for all creatures great and small (especially the small ones).

My allusion to Simon's catchy line is no accident. The musician met the biologist fifteen years ago at a TED conference and was inspired by Wilson's vision for what our world could be. The two men became friends, and Simon devoted a 2017 tour to raising funds for the E.O. Wilson Foundation.

In addition to rock icons, Wilson influenced countless students, teachers, and scientists over his truly epic career. His chief tools were his pen, his vision, and his Southern charm—a personal warmth that belied a difficult childhood growing up in Alabama. In addition to losing the use of one eye in a fishing accident, he had to deal with the challenges of being an only child of unhappy parents.

Perhaps the first person Wilson impressed was his fifth-grade teacher during a brief interlude living in Washington, D.C. "Ed has genuine writing ability, and when he combines that with his great knowledge of insects, he produces fine results," she wrote in one of the most prophetic report cards of the twentieth century.

Those fine results would include two Pulitzer-Prize–winning books (*On Human Nature* and *The Ants*, coauthored with Bert Hölldobler)—although I will disclose that my favorite of all Wilson's writings is his autobiography, *Naturalist*. Wilson's

E.O. Wilson with Sean B. Carroll (left) at the E.O. Wilson Biodiversity Foundation and National Geographic's Half-Earth Day celebration event on October 23, 2017. Photo credit: Tony Powell.

tales of growing up exploring the Alabama woods, his adventures in Melanesia, and his seminal work in the Florida Keys are treasures that should be shared with every budding naturalist or scientist.

Wilson was often likened to a modern-day Charles Darwin. In temperament, his thirst for adventure, and his profound love of all living things (he coined the term *biophilia*), the comparison was apt. He conjured his nineteenth-century forefather when he wrote of exploring the tiny mangrove islets of the Florida Keys:

> No one but a naturalist or escaped convict would choose to traverse the gluelike mud flats or climb through the tangled prop roots and trunks of the mangrove trees. … I drifted along from landfall to landfall, collecting specimens, studying charts, filling my notebook with impressions. Mine was anything but a world-class voyage, but I was as content as Darwin on the voyage of the H.M.S. Beagle.

His thirst for adventure was lifelong such that at age eighty-two, he made his first trip to Southern Africa to visit Mozambique's Gorongosa National Park. There, in a magnificent wilderness healing from two decades of conflict and destruction, he discovered more grounds for the optimism that permeated his worldview. He left a trail of inspiration, from encouraging young Mozambican Tonga Tercida to switch career goals from guide to biologist (see https://tinyurl.com/5hvvzx5k) to establishing a new research laboratory in the park. The Edward O. Wilson Laboratory is now headquarters for the training of generations of Mozambican scientists who will lead the country's ambitious conservation efforts.

I have said nothing here of Wilson's many specific scientific achievements; his firsts and their influence can fill many pages. I wanted to give a brief glimpse of a life so well-lived, so engaged with—and so in love with—the world. The fate of our world was his constant concern, expressed in full by his book-length plea to set aside half of the Earth for humans and the other half for nature.

A nonbeliever, Wilson merged that concern while facing his mortality in an Afterword to *Naturalist* that will serve as his epitaph:

> The astonishing depths of wonders in the universe, continuously revealed by science is my temple. The capacity of the informed human mind, liberated at last by the understanding that we are alone and thus the sole stewards of Earth, is my religion. The potential of humanity to turn this planet into a paradise for future generations is my afterlife.

Steven Pinker

Twenty-five years ago, Edward O. Wilson sent me a typed letter of moral support, out of the blue, after I had written a controversial article and was being attacked by the political and religious Right. He recalled the failure of colleagues to support him when he had been a target of vituperation and felt an obligation to support younger scientists who advanced new ideas.

Wilson was warm, unpretentious, genial, courtly, and happy to engage those who disagreed with him, including, at times, me. Late in his career, he claims to have rethought the widespread rejection of group selection as an explanation for altruism, though the record shows that he had never relinquished the idea in the first place. He held it even during the heyday of William Hamilton, George Williams, and Richard Dawkins, who showed that adaptations are for the benefit of the gene. Wilson tried to push the idea that people are nice to each other only because it makes their tribe more formidable in warfare, which I find neither plausible nor theoretically warranted.

Wilson was known within evolutionary biology for his expertise on all things myrmecological and for his daring work on island biogeography (imagine fumigating a mangrove island for the sake of science today!).

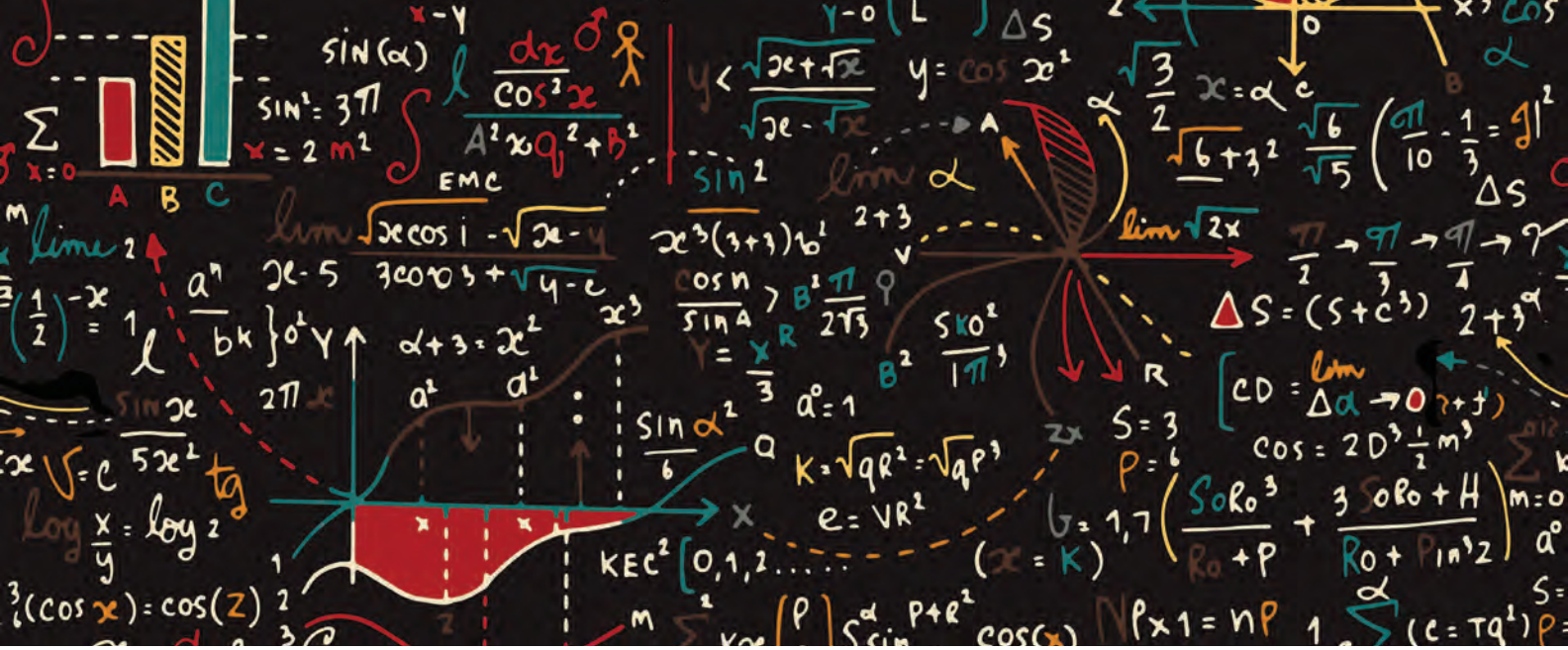
He became infamous in the public sphere for his treatment in *Sociobiology* of *Homo sapiens* as just another kind of animal shaped by natural selection, including its behavior. This was a kind of foray into psychology, though Wilson was neither trained in nor a substantive contributor to that field. He didn't really distinguish between internal motivation, which could plausibly be a target of selection, and overt behavior, which depends critically on context and compromise. But the very idea that human psychology could be illuminated by evolution was a thoughtcrime in the 1970s, and in many discussions the concept of human nature retains its aura of taboo today. Surely one of his greatest contributions was to challenge that taboo.

Edward O. Wilson deserves additional credit for advancing two ideas, each captured in a book title: *biophilia*, the pleasure and comfort we take in natural living environments, and *consilience*, the unity of knowledge despite academic silos. ■

Richard Dawkins is author of *The Selfish Gene* and other books on evolutionary biology plus, most recently, *Books Do Furnish a Life* and *Flights of Fancy*.

Sean B. Carroll is Distinguished Professor of Biology at the University of Maryland and vice president for science education of the Howard Hughes Medical Institute.

Steven Pinker is the Johnstone Family Professor of Psychology at Harvard University and author of *Rationality* and *Enlightenment Now*.



The Failures of Mathematical Anti-Evolutionism

For the past fifteen years, the anti-evolutionist literature has been dominated by mathematical arguments, typically drawn from probability theory, information theory, and combinatorial search. But they have fatal conceptual flaws at their core.

JASON ROSENHOUSE

Mathematics has long had a place in the arsenal of anti-evolutionism, but in recent years it has become especially prominent. This is understandable because mathematics affords the possibility of an "in-principle" argument against evolution. If you can carry out a calculation to show that evolution is impossible or can appeal to an abstract mathematical principle that rules it out, then all the circumstantial evidence in the world will not save the theory. If the numbers do not add up, then the theory is wrong—regardless of any inferences you draw from paleontology, anatomy, genetics, embryology, and so on.

It is like representing a defendant at a criminal trial. One approach is to challenge each piece of evidence against your client individually in the hope of creating reasonable doubt. But a far better approach, if it is available, is to show that your client simply cannot be guilty. If he has an ironclad alibi or is just physically incapable of having committed the crime, then he is not guilty regardless of any evidence against him.

For the past fifteen years, the anti-evolutionist literature has been dominated by mathematical arguments, typically drawn from the fields of probability theory, information theory, and combinatorial search. These arguments are often presented with copious mathematical jargon and notation, which can make them difficult to parse for people not immersed in the relevant fields. By making liberal use of mathematical symbols, Greek letters, and subscripts, it is easy to create the illusion that something profound has been said. But when the arguments are shorn of their technical pretensions and presented in readily comprehensible language, it is never difficult to spot the fatal conceptual flaws at their core. Scientists are right to scoff at them, just as they rightly scoff at the anti-evolution arguments drawn from other branches of science.

What follows will provide a quick guide to the main themes of anti-evolutionary mathematics and explain in plain terms why these arguments fail.

Probability

Leaving aside religious concerns, evolution appears implausible to some because it seems to imply that something very unlikely has occurred. Evolution says that natural forces have led organisms to become more complex over time, but our everyday experience is that things break down unless energy and intelligence is expended to maintain them. Since probability is the branch of mathematics that quantifies our intuitions as to what is likely and what is not, it is natural that it should appear in anti-evolutionist literature.

You are probably familiar with elementary applications of probability. For example, when we flip a fair coin, we say that heads and tails each have a probability of 1/2. The fraction's

denominator indicates that there are two possible outcomes (heads or tails), and we assume that each is equally likely to appear. If we flip a coin twice, then each of the four outcomes (HH, HT, TH, TT) has a probability of 1/4, which is the same as 1/2 times 1/2. There are eight sequences of three Hs and Ts (HHH, HHT, HTH, THH, HTT, THT, TTH, and TTT). Since each of these sequences is as likely as any other, the probability of any one of them is 1/8, which is the same as 1/2 times 1/2 times 1/2. Generalizing from these examples, if we toss a coin x times, then the probability of any specific sequence is 1/2 multiplied by itself x times. If x is large, then this will be a very small number.

A classic anti-evolutionist argument now goes like this: A gene can be viewed as a sequence of DNA bases, typically represented by the letters A, C, G, and T. A gene can therefore be viewed as a sequence of letters, just as the outcomes of multiple coin tosses can be viewed as a sequence of Hs and Ts. If a specific gene is, say, 100 bases long, then the probability of getting just that sequence by random chance is 1/4 multiplied by itself 100 times. This is such a small number, the argument continues, that it could not possibly have been the outcome of a naturalistic process and must instead have arisen through intelligent design. Sometimes the argument refers to proteins (which can be viewed as sequences of amino acids) instead of genes, and sometimes additional biological details are invoked that in no way affect the logic of the argument. In various forms, this argument has long been a mainstay of creationist literature. For examples, have a look at Morris and Parker (1987, 97–100), Roth (1998, 69–70), and Foster (1999).

However, this argument is premised on the notion that genes and proteins evolve through a process analogous to tossing a coin multiple times. This is untrue because there is nothing analogous to natural selection when you are tossing coins. Natural selection is a non-random process, and this fundamentally affects the probability of evolving a particular gene.

To see why, suppose we toss 100 coins in the hopes of obtaining 100 heads. One approach is to throw all 100 coins at once, repeatedly, until all 100 happen to land heads at the same time. Of course, this is exceedingly unlikely to occur. An alternative approach is to flip all 100 coins, leave the ones that landed heads as they are, and then toss again only those that landed tails. We continue in this manner until all 100 coins show heads, which, under this procedure, will happen before too long. The creationist argument assumes that evolution must proceed in a manner comparable to the first approach, when really it has far more in common with the second.

The failure to consider the role of natural selection in evolution is really such a crass blunder that scientists rightly consider the persistence of such arguments among anti-evolutionists evidence of their fundamental lack of good faith. Modern proponents of intelligent design (ID) are usually too sophisticated to make such an error. Instead, they present a superficially more sophisticated probability-based argument. Their idea is best illustrated by example.

Let us return to coin-tossing. Suppose we toss a coin 100 times, thereby producing a chaotic jumble of heads and tails. It was very unlikely that just that sequence would appear, but we do not suspect trickery. After all, *something* had to happen. But now suppose we obtained 100 Hs or a perfect alternation of Hs and Ts. Now we probably would suspect trickery of some kind. Such sequences are not only improbable but also match a recognizable pattern. ID proponents argue that it is the combination of improbability and matching a pattern that makes them suspect that something other than chance or purely natural processes are at work. They use the phrase "complex, specified information" to capture this idea. In this context, "complex" just means "improbable," and "specified" means "matches a pattern."

As applied to biology, the argument goes like this: Consider a complex, biological adaptation such as the flagellum used by some bacteria to propel themselves through liquid. The flagellum is a machine constructed from numerous individual proteins working in concert. Finding this exact functional arrangement of proteins is extremely unlikely to happen by chance. Moreover, they continue, the structure of the flagellum is strongly analogous to the sort of outboard motor we might use to propel a boat. Therefore, the flagellum exhibits both complexity and specificity, and it therefore must be the product of intelligent design.

The most prominent defender of this argument is ID proponent William Dembski. He has presented it in numerous books and essays, most notably in his book *No Free Lunch* (Dembski 2002). Dembski presents his argument with a copious amount of mathematical notation and jargon. However, while his argument contributes some superficial sophistication, it is ultimately no improvement over what we have seen.

Let us address the issue of "specificity" first. There is a danger that saying that a flagellum looks like an outboard motor is comparable to saying that a fluffy, cumulus cloud looks like a dragon. We need to be able to distinguish the design-suggesting patterns from the ones we impose on nature through excessive imagination. Biologists say that natural selection produces functional structures as a matter of course. Thus, when we see a resemblance between a flagellum and a motor, are we seeing a design-suggesting pattern, or are we seeing something that is readily explained by natural selection?

In simplistic examples such as coin tossing, we have extensive background knowledge to help us with this problem. We know what usually happens when coins are tossed, and that enables us to distinguish design-suggesting patterns from what normally happens. Likewise for another example ID proponents use to illustrate specificity: Mt. Rushmore. We know what mountains look like when people do not carve faces into them, and this allows us to recognize Mt. Rushmore as the product of intelligent design. This sort of background knowledge is precisely what we lack in the case of evolution. When it comes to biological adaptations, we have no base of experience for distinguishing design-suggesting patterns from the ones explicable by natural processes.

The argument likewise founders on the question of complexity. According to ID proponents, establishing complexity

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requires carrying out a probability calculation, but we have no means for carrying out such a computation in this context. The evolutionary process is affected by so many variables that there is no hope of quantifying them for the purposes of evaluating such a probability.

In summary, any anti-evolutionist argument based on probability theory can simply be dismissed out of hand. There is no way to carry out a meaningful calculation, and adding "specificity" to the mix does nothing to improve the argument.

Information and Combinatorial Search

A different approach to anti-evolutionary mathematics invokes information theory instead of probability. The basic argument is this: Genes encode meaningful information, and such information is always the hallmark of intelligent design. Natural processes only lead to weathering, erosion, and the breakdown of functional structures. In particular, genetic mutations, which are said to lie at the heart of evolutionary theory, can only lead to losses of information. Therefore, complex genetic information cannot be the result of a naturalistic process. For examples of this sort of argument, have a look at the book by Gitt (2001) or the paper by McIntosh (2009, 375).

By speaking of increases or decreases in information, we are presupposing we have some way of quantifying information. (How else can we determine that some process leaves us with more or less information than we started with?) This is where the mathematics comes in. Mathematicians have devised several methods for measuring information content, the most well-known being the system developed by Claude Shannon in 1948. Roughly, Shannon's idea was that information content is closely related to probability; we learn more information from low-probability events than from high-probability events. His system provides the tools for quantifying this intuition, and these tools ultimately lead to a fruitful mathematical theory of information.

Anti-evolutionists frequently refer to the technical minutiae of information theory in their discourse, but such references do nothing to help their argument. Known genetic mechanisms are fully adequate to explain the growth of genetic information through the evolutionary process. One especially important mechanism plays out when a gene duplicates itself, thereby leaving the organism with two copies of a gene that previously occurred only once. The second copy is then free to acquire mutations without harming the organism because the first gene is there to carry out the original function.

This process is analogous to increasing the information stored on a computer by inserting a thumb drive. Inserting the drive is comparable to the duplication event; it increases the information storage capacity of the computer just as the duplication increases the storage capacity of the genome. When new files are placed on the drive, the quantity of information stored on the computer has increased, just as mutations in the duplicate copy lead to new genetic information.

Therefore, any claim to the effect that genetic mutations can only degrade information can be dismissed as simply empirically false. Moreover, we should note that this claim is logically impossible. After all, if the mutation from A to B represents a loss of information, then the reverse mutation from B back to A must represent a gain of information.

Modern ID proponents have tried a different approach to these sorts of arguments, invoking the branch of mathematics known as *combinatorial search*. We can illustrate their main idea with an analogy.

Any claim to the effect that genetic mutations can only degrade information can be dismissed as simply empirically false.

You have probably seen word search puzzles in which a small number of meaningful words are concealed in a large array of meaningless letters. If you have ever tried to solve such puzzles, you know that it is very inefficient, and not a whole lot of fun, to examine every letter in all eight directions looking for words. Instead, you quickly hit on the trick of looking for pairs or triples of letters at the same time. You can also look for unusual letter combinations that will stand out against the background. For example, if your word has a Q in it, then you need to look for QU pairs. The point is that if you search for small targets in large spaces, then you need some kind of edge. Blind search is not going to cut it.

There is a sense in which the evolutionary process can also be viewed as a search problem. The small targets are the various complex adaptations used by organisms to survive. The large space is the collection of all theoretically possible gene sequences, most of which do not code for anything useful. Scientists claim that natural selection provides the needed edge for evolution to find the small targets in the large space. The set of all possible gene sequences is incredibly vast, but this is irrelevant because natural selection shifts the probability distribution dramatically toward the functional sequences and away from the nonfunctional sequences.

In the language of combinatorial search, the "edge" to which I refer is called an "algorithm." Researchers in this area have devised a variety of algorithms for tackling different sorts of search problems. In practical applications drawn from physics and engineering, the researcher always uses back-

ground knowledge about the specific problem to be solved to select the most appropriate search algorithm. It would be nice if there were an all-purpose algorithm that would be effective regardless of the specific properties of the space to be searched.

And this is where ID proponents see a point of attack. There is a collection of specific mathematical results, referred to as "No Free Lunch" theorems, that prove that there is no all-purpose algorithm. If an algorithm is effective for some search problems, it is necessarily ineffective on others. And if that is the case, then whatever success natural selection has as a search algorithm can result only from intelligent tailoring of the algorithm to the problem. Just as mathematicians use their intelligence to fit their search algorithms to specific problems, so too, the argument runs, must a greater intelligence have made the laws of nature such as to allow Darwinian evolution to operate. This line of attack was first presented by Dembski, again in his book *No Free Lunch*. It has since been elaborated upon in the more recent book by Marks, Dembski, and Ewert (2017).

There is much to be said against this argument. The No Free Lunch theorems are legitimate and important mathematical results, but as with all such theorems there is a wealth of technical detail to wade through before applying them to specific physical cases. Mathematicians and philosophers have cogently argued that evolution simply is not a search process in the precise sense addressed by the theorems. Developing this line of response requires more attention to minutiae than I can provide in a short article, but I would refer the interested reader to the book by Sarkar (2007, chapter 5) or the paper by Perakh (2005) for careful developments of this argument.

For our purposes, the main flaw lies elsewhere. Even if we accept everything Dembski and his coauthors are saying about these theorems, this whole line of attack simply amounts to nothing. Most of us did not need difficult mathematical theorems to understand that Darwinian evolution can work only if nature has certain properties. The search problem confronted by evolution arises ultimately from the laws of physics, but it is well outside biology's domain to wonder why those laws are as they are. Dembski and his cohorts argue that the fundamental constants of the universe encode information of a sort that can arise only from an intelligent source, but they have no more basis for this claim than they did for the comparable claim about genetic sequences.

The Futility of Anti-Evolutionary Mathematics

I have addressed a few of the principal errors in anti-evolutionary mathematics, but there is far more wrong with these arguments than I can present here. For their part, the anti-evolutionists have presented many variations on the basic themes I have discussed, and it would require writing at book length to address every claim individually. Let me close, then, by noting that we do not need to address every individual nuance of mathematical anti-evolutionism to be deeply skeptical of the entire enterprise.

This article began by saying that mathematics affords the possibility of an "in-principle" argument against evolution. But is it plausible to think that any such argument could possibly succeed?

The basic ingredients of evolutionary theory are simple, empirical facts. Genes really do mutate, sometimes leading to new functionalities, and natural selection really can string together several such mutations into directional, evolutionary change. On a small scale, this has all been demonstrated and observed. But if evolution can produce small changes over short time periods, what abstract mathematical principle is going to rule out larger changes over longer time periods? If there is a mechanism for small change, then how can any calculation or abstract theorem rule out simply repeating the process to produce large change?

Everyone agrees that complex adaptations require a special sort of explanation. Scientists argue that actual biological systems show copious evidence of having resulted through evolution by natural selection. Anti-evolutionists reject this claim, but the ensuing debate, such as it is, has nothing to do with mathematics. This makes you wonder why anti-evolutionists insist on padding their work with so much irrelevant and erroneous mathematical formalism. The answer is that their literature has far more to do with propaganda than it does with serious argument. Mathematics is unique in its ability to bamboozle a lay audience, making it well suited to their purposes. But for all its superficial sophistication, anti-evolutionary mathematics is not even successful at raising interesting questions about evolution. ■

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Stonehenge. Photo by the author.

Revisiting the 'Stonehenge Surprise': The 'Best Case' for Crop Circles?

Mystery-mongering claims about a "suddenly appearing" intricate crop circle across from Stonehenge fail skeptical investigation.

BENJAMIN RADFORD

On Sunday, July 7, 1996, what has been called "one of the most complex and spectacular crop circle designs ever seen" (Andrews 2009) appeared in England. It was an astonishing fractal pattern called a Julia Set, which clearly demonstrates some sort of intelligence. It is unique in crop circle history for several reasons, including the fact that it appeared not far from the mysterious and world-famous Stonehenge monument in the English countryside—and that it allegedly appeared during daylight in less than an hour.

The circle became one of the most famous and important crop circles in history and has been claimed to be one of the best cases for crop circles. Indeed, "Noted researcher Colin Andrews expressed the sentiments of many when he said at several public conferences … 'If these Julia Sets can be proven to be made by humans, then we can all pack our bags and go home'" (Lindemann 1996).

The Julia Set Appears

In addition to claims that have become standard with most significant crop circles (such as the difficulty of making the designs and quotes by occasional baffled "experts"), this strange case has many unique features. The circumstances surrounding its appearance are, at first glance, straightforward and impressive enough: A pilot flew over the field opposite Stonehenge late one afternoon and saw a normal, undisturbed field below; on his return flight less than an hour later, the pilot was stunned to see the spectacular 600-foot fractal crop circle below in that very same field. Soon word of the circle's discovery spread, and it made international news.

Yet there exists no photographs or video of it being made; it seemingly spontaneously appeared in minutes. The validity of this crop circle rests almost entirely on eyewitness testimony and a timeline of events suggesting that the crop circle must have appeared in between the two flights, approximately twenty to forty-five minutes apart.

Was It a Hoax?

The question of hoaxing was soon raised. Hoaxing is undeniably rampant for crop circles. Skeptics suggest that crop

circles are man-made; believers acknowledge some hoaxes but insist that many of the patterns cannot be hoaxed. This case in particular has several aspects that, if true, seem to rule out hoaxing. For example, not even the fastest hoaxer could hope to create such a complex pattern so quickly; they might have been able to make a few of the simple circles in under an hour, but such a fractal series would truly require superhuman—or perhaps supernatural or extraterrestrial—abilities. If the story is true as told, it is a genuine mystery.

The hoaxing explanation gained credence in 1996 when researcher Michael Lindemann interviewed a man named Rod Dickinson, who confessed to making it—or at least knowing who did. Dickinson answered the claim that the circle was created in about forty-five minutes. "'That isn't true,' Rod insisted. 'It was made the previous night, by three people, in about two and three-quarters hours, starting around 2:45 am (on Sunday morning, July 7). It was there all that day."

How exactly could the Julia Set have been created?

> You start with the large central circle, which is placed right next to a tram line. People asked why it had the large central circle, which is a little out of place in a Julia Set. Simple. To avoid damaging surrounding crop, you have to have a large central area already layed [*sic*] down, from which you can measure out diameters to other parts of the formation. After making the first circle, they measured out a work line for the rest of the formation. (Lindemann 1996)

Indeed, that is precisely how Joe Nickell, Kevin Christopher, and I made crop circles with "stalk stompers" during investigations (see Nickell 2004 and Radford 2010).

The Eyewitnesses

Many crop circle researchers dismiss the hoaxing claims because, they say, there are simply too many firsthand witnesses in this case. Indeed, the Stonehenge Surprise involves a large number (and variety) of potential eyewitnesses. Colin Andrews, who has written at length about this mystery, sums up the key point of the anti-hoaxing argument: "It is farfetched to believe that an entire day went by without anyone seeing the enormous formation—including the farmer who owned and worked the fields" (Andrews and Spignesi 2003). But just how farfetched is it?

Andrews wrote in his 2003 book, *Crop Circles: Signs of Contact*:

> One of the most convincing arguments for the Julia Set's authenticity is that honest, respectable people have attested to its almost instantaneous appearance. These are credible people telling of incredible things. Nowhere is this more evident than in the accounts provided by people who would have nothing to gain, and a great deal to lose, by making up such a story. (Andrews and Spignesi 2003)

This is of course a false choice logical fallacy: suggesting that *either* the crop circle must be authentic *or* any eyewitnesses vouching for its authenticity must be lying. Yet we need not accuse anyone of deception when another, more likely and charitable, explanation is that people may simply be mistaken or inattentive. With that in mind, let's examine the most widely cited accounts of who saw what, and when, starting in chronological order.

The Night Before the Sighting: The Stonehenge Guards

The hoaxing explanation has been dismissed by some who claim that if the crop circle had been made the night before it was discovered, it surely would have been seen much earlier and the hoaxers spotted in the act. Andrews makes much of the fact that

> The Stonehenge site, which is across the road from the field where the Julia Set appeared, is guarded 24 hours a day by a team of at least three, and often, four professional security guards. These guards can see the field from the patrolled, elevated ground on the northern side of the Stonehenge standing stones, but they did not see the pattern until after 6 p.m. on the day it appeared.

Andrews paints a picture of a team of professionals vigilantly and constantly scanning the skies and surrounding fields for anything unusual. Yet their charge was right in front of them—the ancient stones and their immediate surroundings. The guards were not being paid to watch over neighboring farmers' fields, and for all we know—like many night-shift security guards—they passed another uneventful night playing cards, listening to music, or chatting. There's no reason to think they would necessarily have seen three people

You are here
The Stonehenge Cursus is a 1.7 mile long rectangular monument defined by a bank and ditch. We don't know the purpose or meaning of this huge enclosure, but its presence in the landscape may have influenced the siting of Stonehenge several centuries later.

Figure 1. An informational plaque at Stonehenge showing an aerial view of the area; the Julia Set crop circle appeared in the foreground. Photo by the author.

in a dark field across a highway in the dead of night.

Furthermore, this argument ignores the fact that the A303 highway lies between the Stonehenge security guards and where the circle was made (see Figure 1). Andrews and others eagerly describe how heavily traveled the road is yet fail to realize that any lights that might have been created by the hoaxers and seen from Stonehenge would likely be ignored as coming from passing vehicles. Even if a few flashes of light had been seen from that angle from a field across the headlight-streaked A303, the guards would not be allowed to leave their post to investigate something on private property.

The Morning of the Sighting: The Farmer

The first person who (retrospectively) claimed to have examined the area where the circle appeared was the farmer who owned the field, a Mr. Sandell. The authors of the book *Crop Circles: Exploring the Designs and Mysteries* state that "Farmer Sandell claims to have personally inspected the field on that Sunday morning and not noticed anything unusual" (Anderhub and Roth 2002, 38). Assuming he made that statement, the claim that Sandell "personally inspected the field on that Sunday morning" is rather unlikely to mean what the authors (and others) seem to think it means. The confusion may stem from urban crop circle researchers and writers misunderstanding the nuances of an agricultural farmer's daily life and routine.

Farmers do not routinely and personally inspect their entire crop. When a farmer speaks of *inspecting a field*, this does not mean that he personally walks back and forth through each field or that he hires a helicopter to fly over his crops just to have a look at them from the air. Instead, "inspecting a field" typically means going to the edge of a field at the most convenient and accessible location and inspecting the condition of some of the plants growing there. There's no reason for a farmer to venture into the field itself during a routine inspection, because the plants at the edge of the field are (quite reasonably) assumed to be representative of the condition of the plants in the rest of the field. It would be pointless, impractical, and indeed impossible for farmers and their hands to do the sort of close personal inspection of their fields that crop circle researchers suggest had been done the morning before the circle was discovered, thus "proving" that it could not have been there.

Before and after the Sighting: The Pilot(s)

By far the most important eyewitness in this case was the pilot who first spotted the crop circle below. As Colin Andrews, head of Colin Andrews Circles Phenomenon Research International, notes:

> The formation was first spotted from an aircraft at 6:15 PM. The pilot crossed over the field with a passenger (a medical doctor taking pictures) at 5:30 PM and both reported that there was no formation in the field at that time. … [Later] The pilot took off again and crossed the field at 6:15 when he saw the Julia Set formation in the field. (Andrews 2009)

The Julia Set

If this account is true, and the crop circle did not exist at 5:30 p.m. on the pilot's first flight, this fact should be easily proven by an examination of the aerial photographs supposedly taken by the (curiously anonymous) medical doctor passenger. Yet, strangely, these photographs never seem to have surfaced; surely if they indisputably showed an undisturbed field across from Stonehenge any time before 6 p.m., Andrews would have been eagerly touting them.[1]

Before and after the Sighting: A303 Motorists

The press notes for the film *Crop Circles: Quest for Truth*, from Academy Award–nominated director William Gazecki, offer the Stonehenge Surprise as one of the most important and more baffling crop circles in history, because it "appeared in full view of the busy A303 road, opposite England's ancient monument Stonehenge, within a 45 minute period

The view from Stonehenge across the A303 highway to where the crop circle appeared. Photo by the author.

one Sunday afternoon" (Gazecki 2002).

With a few corrected facts and clarified assumptions, Gazecki's breathless statements can be seen in a different light. The Julia Set did not in fact appear "in full view of of the busy A303 road." The A303 road can indeed be busy at times, but it is not constantly busy, and in any event the topography is incorrect. Perhaps if the field had been located on the side of a steep hill facing the A303 it would be in "full view," but for most of the roadway in the area, it was about at the same level, and of course obscured by tall wheat on either side. As Rod Dickinson noted, "If you went there, you'd see how the field slopes down and away from the road. The formation was in a kind of bowl, below the level of the road. Going by in a car, you couldn't see it. You would have to get out and walk toward it and look down into that bowl-shaped area to see it" (Lindemann 1996).

It is important to remember that the field where the circle appeared is in the opposite direction of Stonehenge. When passing through the area, most drivers and passengers will naturally direct their attention to the side of the road where one of the world's most famous monuments sits—not the (presumably) empty wheat fields on the other side. This is not to say, of course, that a few passing motorists may not have glanced in the direction of that field at some point as they drove by. But the suggestion that drivers would have been paying attention to a particular patch of field that's identical to countless miles of fields coming before and after—instead of hoping to catch a glimpse of Stonehenge—is absurd.

The Mysterious 'M'

Crop circles are notoriously shy; there are no authenticated photographs, films, or videotapes of crop circles appearing spontaneously. For skeptics, this is considered strong evidence that the circles are made by hoaxers. After all, if it is some natural (or even supernatural) phenomenon—even if the circles can be traced back to extraterrestrials, ley lines, or something else—there's no logical reason it couldn't be recorded on cameras. Furthermore, unlike many other Fortean phenomena, there is a glaring dearth of firsthand eyewitness accounts of crop circles being formed.

Except, it is claimed, in this case. Just as the Stonehenge Surprise is said to be unique in several other ways, according to prominent crop circle researcher Lucy Pringle, it is also the first time that a crop circle was witnessed being formed right before the amazed eyes of dozens of eyewitnesses. According to Pringle, a witness she refers to as "M" (whom she first heard about from a friend of a friend of a taxi cab driver) and a passenger drove on the A303 in July 1996. As they passed Stonehenge, they noticed the crop circle and a large number of cars pulled over to the side of the road near the field opposite the famous site. Curious, the pair pulled over:

> [They] got out and joined the crowd of other people who were also watching what was happening. "There was an apparition, an isolated mist over it and as the circle was getting bigger the mist was rising above the circle. As the mist rose it got bigger and corn circle got bigger," M said. "There was a mist about 2–3 feet off the ground and it was sort of spinning around and on the ground a circular shape was appearing which seemed to get bigger and bigger as simultaneously the mist get bigger and bigger and swirled faster. It was gradual and you are standing there and you are thinking *What is going on* and everyone is discussing it and more and more traffic is building up and everything." (Pringle 2009)

M claimed to have stayed there for about twenty minutes before the pair got back on their way, only relating the incident to a taxi driver some *thirteen years after the fact*. M remains the only person in the world who has told this story; no one else has come forward to corroborate it.

M's account is dramatic—and wholly implausible. For one thing, as has been noted, the crop circle was not visible from the A303 at the point in which it passes Stonehenge, so it's unlikely that M or the car's passenger could have seen it. Second, it strains credulity to suggest that out of the dozens (or hundreds) of people present, not a single person photographed the amazing event or apparently mentioned it to anyone else. No newspapers were called to report something that had never happened before in human history: a unique fractal Julia Set crop circle had been created right before astonished eyewitnesses—and across from Stonehenge, no less!

Most damaging to the story, M's eyewitness account is contradicted by the (presumably credible) pilot who first sighted the crop circle. In his account, the pilot made no mention of the dozens of cars and crowds of people M claims had gathered to gawk at the amazing crop circle (who would have been clearly visible from the air). Recall Colin Andrew's claim that "One of the most convincing arguments for the Julia Set's authenticity is that honest, respectable people" (such as Lucy Pringle's eyewitness "M") "are credible people telling of incredible things [and] have nothing to gain, and a great deal to

lose, by making up such a story." Either the pilot is mistaken (or lying), or M is mistaken (or lying)—they cannot both be correct, and it is curious that Pringle and others have failed to notice (much less explain) this glaring contradiction.

Conclusion

This case offered merely the *illusion* of corroboration; while at first it seemed like an airtight case with a triangulation of evidence (from Stonehenge guards, a local farmer, pilots, and highway motorists) pointing to the same inexplicable conclusion, when I took a closer look at the eyewitnesses, one by one they fell like stalks to the scythe.

Absence of evidence is not evidence of absence, and this case is a perfect example of that axiom: the fact that no one noticed the crop circle in the field until after six o'clock does not mean that the crop circle was not there. The same holds true for the fact that the circle makers were not detected while they worked the previous evening/early morning.

The much-lauded story of the Stonehenge Surprise falters under one of the most important scientific principles, Occam's razor. In this case, the simplest explanation for the (literally) incredible eyewitness account of the Julia Set circle being created is that M is simply lying or mistaken. Similarly, the simplest explanation for the fact that a pilot, Stonehenge guards, farmers, and A303 motorists didn't report the crop circle prior to being sighted at 6 p.m. is that they simply didn't notice it because most people don't spend their time paying attention to farmers' fields looking for anything unusual. And the simplest explanation for the circle itself is that it was created the night before by the three hoaxers who admitted (albeit anonymously) to making it—and not in under an hour in broad daylight.

The simplest explanation is not always the most satisfying one, but in the case of the Stonehenge Surprise, it is surely the correct one. If this crop circle truly is one of the best and most mysterious cases—such that a close look suggesting it was hoaxed should prod researchers to "pack [their] bags and go home"—then croppies may want to start looking for their luggage.

The Stonehenge crop circle case was one of those investigations I was drawn to, not only because it was considered the "best case" for crop circles but also because nobody had solved the mystery. A key lesson I take from this is to not assume that someone would have solved a decades-old mystery. Especially in the realm of the "unexplained" and paranormal, don't assume that any competent or skeptical investigation has been done. In the field of crop circles—as with ghosts, Bigfoot, UFOs, psychics, and more—adequate scholarship is usually the exception instead of the rule, and it's often done by advocates and believers (if done at all). This case, then, highlights the role of investigative skepticism. ■

Note

1. There is some confusion over whether it was the same or a different pilot who saw the field both before and after; Colin Andrews states that it was the same pilot, while Lucy Pringle, in her book *Crop Circles: The Greatest Mystery of Modern Times*, offers another account that differs in several important details. If two well-known crop circle researchers can't agree on basic facts, it raises serious questions about how thoroughly this presumed best case was investigated.

Author Benjamin Radford at Stonehenge.

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Do Moonlight and Hydrogen Peroxide in Dew Whiten Laundry?

That moonlight and dew bleach laundry is a traditional belief, but what's the evidence?

FRANÇOIS-MARIE BREON AND JEAN-JACQUES INGREMEAU

There is a traditional belief that moonlight can be used to bleach laundry linen. Because of the low intensity of moonlight compared to that of sunlight, this appears implausible in light of current scientific understanding. However, J.P. Parisot (1986) suggested that the bleaching effect is real and is caused by the presence of hydrogen peroxide (H_2O_2) in the dew, which is enhanced in cloudless sky conditions when the moon is visible. In this hypothesis, the moonlight would not be a cause but instead correlated with the presence of natural H_2O_2. This physical explanation is now widely used in support of the traditional belief.

To our knowledge, the reality of the effect has never been assessed with a proper scientific study and therefore has not been demonstrated. Whether the effect is real or not, the physical interpretation proposed by Parisot is unlikely, because the measured H_2O_2 concentrations in the atmosphere and natural dew are much lower (by several orders of magnitude) than those required to generate a bleaching effect.

A Traditional Belief

Many popular beliefs exist about the influence of the moon on agriculture, human sleep, and birth rate, although there is no solid evidence of such effects. In fact, the results of analysis using scientific methods often contradict the popular beliefs (see, for example, Morton-Pradhan et al. 2005; Beeson 1946; Mayoral et al. 2020). One of them concerns a traditional belief that moonlight will bleach laundry. It is notably attested by sayings such as the French *La lune mange les rideaux* ("The moon eats the curtains") and in various online content in French and English (see sidebar). This lunar bleaching power is supposed to be superior to that of the sun, and it is therefore customary to spread laundry on the ground in the grass on evenings of the full moon to whiten it (Parisot 1986). This belief is notably invoked in the explanations of the traditional technique of "bleaching in the meadows" of Gérardmer in France, practiced since the eighteenth century until the first half of the twentieth century.

A Possible Explanation

In 1985, J.P. Parisot proposed a scientific explanation for this belief: the bleaching effect could be caused by the presence of H_2O_2 in dew. People wrongly attributed the whitening effect to the moon, but it was actually due to the H_2O_2 naturally present in dew, which is enhanced when the sky is cloudless and the moon is more visible.

Parisot described the atmospheric chemical reactions leading to such H_2O_2 creation in the dew and made a theoretical calculation to evaluate its production (Parisot 1986). The paper does not claim to provide proof that things really happen this way; it simply suggests that this could be an explanation that remains to be confirmed.

With lunar laundry lightening understandably not the subject of major scientific interest, Parisot's scientific publications remain unchallenged. His paper is not cited by any other peer-reviewed publications. The fact that the published paper was written in French is likely also a factor for its absence of impact on the scientific community.

But in the field of science popularization, presumed influences of the moon remain a subject of interest, and many French books, press articles, blogs, websites, and forums refer to this paper. This explanation is widely presented as valid because it is seen as one of the few beliefs associated with the moon that are partially true and explained by science rather than by our cognitive biases. This is notably the case in the French books *Sous l'emprise de la Lune* by Jérome Bellayer (2011) and *Astronomie de l'étrange* by Yaël Nazé (2021). In a dozen various online sources consulted, all refer to this single publication to justify the reality of the phenomenon (see sidebar).

A Concentration Issue

Here we analyze whether the H_2O_2-in-dew interpretation is valid. This chemical has been measured extensively, and typical concentrations are provided in published papers. H. Sakugawa and I.R. Kaplan (1993) find 10 to 90 μM (micro-mol per liter) in rain and clouds, but <1 μM in dew collected over mountains of Southern California. V. Ortiz et al. (2000) made extensive measurements in the vicinity of Santiago, Chile, and found an average concentration of 5.4 μM in rain and 2.2 μM in dew. K. Watanabe et al. (2009) reported concentrations in dew waters of a few ppm, although one sample collected in high altitude showed a value as high as 65 μM. These measurements show significant variability but clearly indicate that the typical concentration of H_2O_2in dew is at most a few μM. As there are 56 moles of H_2O_2 per liter, the relative concentration $[H_2O_2]$/

[H_2O] is on the order of 10^{-7}, or one part in 10 million.

Parisot made an estimate of the H_2O_2 concentration that may be dissolved in water during a day and found 0.71 g m^{-2}, though he did not extend his estimates to the potential concentration in the dew. Typical dew deposits at night are 100 to a few hundred g m^{-2} (e.g., Jacobs et al. 1999; Andrade 2003), so the Parisot estimate is equivalent to a [H_2O_2/H_2O] concentration of 10^{-2} to 10^{-3}, much larger than that of actual measurements.

Using "artificial" H_2O_2 for bleaching laundry used to be a common practice that remains recommended in books and on internet sites. For this purpose, the recommended concentration of H_2O_2 to be included in the water varies between 10^{-1} and 10^{-2}. Even the 10^{-2} concentration is five orders of magnitude larger than what is found in typical dew and four orders of magnitude larger than the highest natural concentration recorded. No effect is expected at these concentrations. Clearly, the fact that H_2O_2 is used to whiten laundry can hardly be used to justify that the same process is occurring with dew, because the concentrations in dew are so much lower. The concentration estimates made by Parisot would have made the process plausible, but the practical effects do not.

To our knowledge, there is no rigorous experimental demonstration that laundry tends to whiten when exposed to moonlight, despite countless testimonials to the contrary. ■

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Indian Astrology: A Reality Check

When astrologers fail double-blind tests, supporters often defend astrology by implying the failure is that of the astrologers rather than astrology itself. Empirical research sheds light on the matter.

NAGESH RAJOPADHYE AND PRAKASH GHATPANDE

In India, astrological matchmaking is invariably the very first filter applied in the selection process of arranged marriages. Close to 90 percent of marriages in India are arranged, so clearly astrology is very popular. This popularity warrants scientific and transparent testing of Indian astrology, but, perhaps surprisingly, to date no astrologers have aggressively sought to have such testing done.

The double-blind experiment conducted by the noted astrophysicist and science communicator Jayant Narlikar should be viewed as a pioneering effort to test astrology in India. Narlikar, recipient of the Padm Vibhushan, India's second highest civilian award, published the results of the test widely, including in an article in Skeptical Inquirer (Narlikar 2013). His research generated a lot of debate because it revealed that none of the astrologers could perform better than chance, 50 percent. However, as in many double-blind experiments, particularly when the outcome is negative, astrology's supporters tried to create ambiguity by questioning whether the results were due to the limitations of astrology or the astrologers themselves. Against this backdrop, we present the results of new empirical tests of a few fundamental principles of Indian astrology, leveraging the same dataset that was used in Narlikar's double-blind test. Interestingly enough, our results showed why Indian astrology failed the double-blind test. It is little wonder that other versions of astrology are found to fail on the same grounds.

The Previous Experiment

Narlikar et al. conducted their double-blind test in Pune, India, in 2008 (Narlikar et al. 2009; Narlikar 2013). In this test, the variable being tested for was clear: namely, whether a person is intellectually and developmentally disabled or intelligent. As part of the test, a sample of 200 birth charts was used, 100 of each of the two classes. From this pool of birth charts, astrologers in the state of Maharashtra, India, were given a random mix of forty astrological birth charts; the identity and details of each person was hidden. Then the astrologers were asked to identify—purely through astrological means—which birth charts belonged to intellectually and developmentally disabled persons and which belonged to intelligent persons. If astrology could tell a person's intelligence or a major attribute such as a disability from a birth chart, it would be expected that astrologers would correctly

classify at least twenty-eight birth charts, 70 percent of the cases given to them. The researchers made an effort to maximize participation by appealing to astrologers and their associations through newspapers and press conferences. In total, twenty-seven astrologers participated in this test, but none could correctly classify with an accuracy of 70 percent or better as required by the test. Overall, average success was 17.25 charts (43.13 percent), even less than chance. The success rate of the single astrologer association that participated, which was given all 200 cases to analyze, was also not up to the mark. They could only hit 102 cases correctly, well below the stipulated minimum of 117 required to make a case for astrology. Thus, Narlikar et al. showed that the predictions given by the astrologers fared no better than pure chance—like tossing a coin.

The New Experiment

Despite several failures in the double-blind test globally, proponents still like to paint astrology as a science. If it is a science, it should be proven through a universal framework of empirical testing. However, no such attempt has been reported to date on Indian astrology (often referred to as Vedic astrology)—nor are there plans by any institutions, including astrologers' associations, to investigate it in detail. Empirical testing of astrology was therefore taken up in our new study by forming two groups. Group A consisted of birth charts of intelligent persons, and Group B consisted of those of intellectually and developmentally disabled persons. The experiment focused on the same criteria that were tested in the previous experiment, namely whether astrology can predict intelligence. Though the core data remained the same, we expanded the base of data to 338 cases in each group to increase the confidence level of the results.

Our design approach for this test was to apply astrological principles, measure the number of cases that comply with the given principle, and compare both groups through statistical methods to see if there was any significant difference. Indian astrology assumes that each planet, house, and lord of the house (hereafter collectively referred to as "entities") in the birth chart is significant for particular life traits (Raman 1996; Rao 2004, 79; Rath 2012, 23). For example, Mercury, fifth house, and lord of the fifth house are said to be significant for the subject's intelligence; Venus, seventh house, and lord of seventh house supposedly are significant for marriage; and so on. One astrology principle states that when the planet is in conjugation with malefic planets, such as Saturn or Mars, its effect is adverse or harmful (Agarwal 2019, 125; Raman 1996; Rao 2004, 100). The counterpart of this principle affirms that if the planet is in conjugation with auspicious planets, such as Jupiter or Venus, then the effect is beneficial. We refer to these two statements as negative and positive principles, respectively. They are considered principles because they are universally applicable to all the planets and used for predicting their respective "significant" effects.

If we apply these principles to a specific entity only, these principles become "rules." For instance, Mercury signifies intelligence, so this rule will be used to predict intelligence either negatively or positively. Similarly, if we apply the same principles to Venus, they will become rules used to predict success in marriage. Similar rules can be made for all the planets. The principles are more generic in nature compared to the rules and are considered foundational to astrology. They are almost universally agreed upon. We focused on them to test astrology because, basically, astrology cannot be practiced without applying them. These principles are primarily based on the assumption that malefic astrological configurations associated with the given entity (planet, house, or lord of house) decrease their ability to have beneficial effects and hence result in undesired characteristics for the life traits for which they are responsible (Agarwal 2019; Rao 2004; Rath 2012). Without contesting the logic of the principles, we decided to test them empirically.

In astrology, there is no universally agreed-upon published list of principles that one can refer to for predicting a given trait. With this in mind, we went through several books and articles (Agarwal 2019; Chatterjee 2017; Krishna 2013; Raman 1996; Rao 2004; Rath 2012), deliberated with some of the astrologers, and decided to test a few of the principles that are given as fundamental principles in the material studied. These principles act as the core framework of Indian astrology. The next step was to decide on applying them to the entities deemed significant for intelligence. When we looked at the diversity of rules being discussed by astrologers in various books and articles (Chauhan 2014; Balajee 2019; Krishna 2013; Rao 2004; Rath 2012) and forums, we came across several planets and houses deemed significant for predicting intelligence. For example, conventionally, Mercury and the Moon are considered significant for predicting intelligence; however, some astrologers believe Uranus and Jupiter have qualities similar to Mercury and are equally responsible for influencing intelligence (Chauhan 2014). When it comes to houses, besides the conventional first house, the fifth and third houses are also claimed to be significant for intelligence. We decided to test the principles applicable to planets for all the planets and principles applicable to houses for all twelve houses. This way, regardless of which of them is significant for intelligence, we would see the difference in at least one of them.

The Experimental Set Up

We developed a computer-based, three-part program to perform the testing.

1) The software for casting the birth charts made use of commercially available APIs (application programming interfaces). Details such as planetary positions, dignities, retrogrades, house numbers, etc., were written in the database using the Lahiri ayanamsa system (Rao 2004, 18).

2) The analyzer engine applied various rules, measured which ones comply, and created a database of the number of cases that complied with the given rule in both groups.

Python-based automation developed in this module enabled the software to cast and process hundreds of birth charts in a single operation.

3) The statistical testing module worked on the database created by the analyzer engine. It filtered the data to create two groups and performed comparisons through the Chi-square statistical test. It was run on the input variable "number of cases that complied with the given rule" for all entities. Here the null hypothesis was defined as "the number of cases complying with the rule of an entity under test in both groups is equal." In other words, this hypothesis is basically saying that there is no difference in compliance of rule in both groups, and hence the particular rule of astrology under test is not valid. The alternative hypothesis is that both groups are *not* equal in numbers of cases, which would support the validity of the rule. We were willing to allow that if there were even a 10 percent difference between the two groups (a hypothetical difference criteria of 10 percent), then the astrological principles we tested are true and offer valid predictions on critical life matters. Because this difference between the two groups would be expected to be much higher—50 percent at least—were astrology true, this 10 percent figure creates a very liberal and easy test for astrological principles to pass. At the same time, testing a null hypothesis with 10 percent hypothetical difference criteria is the most stringent test for us to refute those principles. However, we decided to run the test this way to avoid any ambiguity and give astrological principles the best chance at being proven.

Data

The statistical test calculator (https://surveysystem.com/sscalc.htm) stipulates that we need to have a minimum sample size of 661 (both groups together) to achieve a confidence level of 99 percent with a confidence interval of 5 percent to test the difference in two groups. To ensure we met this criterion, we fed birth details of 338 cases each of intelligent and intellectually and developmentally disabled persons to our three-part program.

The birth details involved in this experiment were collected by a team of volunteers who reached out to various schools in the state of Maharashtra, India, and made a special appeal to parents. In our appeal, we emphasized the objective of the experiment and the need of being accurate in terms of birth date, time, etc. We obtained birth details through a consent form filled out and signed by parents. For cases in Group B, the team approached some special schools being run for intellectually and developmentally disabled students in different parts of the State of Maharashtra, India, and approached parents through the teachers. For intelligent students (Group A), we requested birth details of only those students who were certified as intelligent by their teachers based on their school records. We received 116 names for Group A through these initiatives. This was not a sufficient number, so we added a few cases that we personally collected. The criteria for selection of these additional cases were (a) higher educational qualifications, such as doctorate, postgraduate, MBBS (bachelor of medicine, bachelor of surgery), or certified chartered accountant; (b) age in the range of thirty to forty-two, which is the same as that of Group B; (c) sufficient confidence in the accuracy of data; and (4) no history of mental retardation or other mental disorder.

Statistical Analysis

Principles Applicable for Planets

The results of the six fundamental principles we tested for

various planets are given in Table 1. For this article, let us call them "negative principles" because they are considered to predict malefic or negative effects in life. A description of the principle we tested and the analysis of results are given below.

Rule P1—Planet in the Sixth, Eighth, or Twelfth House: This principle is one of the primary negative principles considered for predicting any adverse effect. For instance, to predict an intellectually and developmentally disabled person, this rule will be checked for planets considered "significant" for predicting intelligence. Mathematically, this is the probability that a planet is in the zodiac sign of x+5, x+7, or x+11 when x is the zodiac sign number of ascendant. Regardless of which planet is significant for intelligence, we find that none of the planets have a significantly higher probability of getting placed in these zodiac signs when the person belongs to the intellectually and developmentally disabled group. The chi-square test confirms further that the null hypothesis cannot be rejected based on p values for any of the planets; hence, this principle was not found to be valid.

Rule P2—Planet in Conjugation, Square, or Opposite to Saturn, Mars, Rahu, Ketu, or Uranus: This principle deals with the probability of a planet having a difference of 0, 90, or 180 degrees (allowing deviation of ±4 degrees) with one of the five malefic planets, namely Saturn, Mars, Rahu, Ketu, or Uranus. (Astronomically, Rahu and Ketu denote the points of intersection of the paths of the Sun and the Moon as they move on the celestial sphere. Vedic astrology treats these two points as planets and uses them for predictions.) Indian astrology assumes that such configuration results in malefic effects related to the significance of the planet. Again, we find that none of the planets or ascendant have a significantly higher percentage of such configurations in Group B versus Group A despite having opposite life patterns. The principle was therefore disproved.

Rule P3—Planet in Debilitated or Enemy Sign: This principle anticipates a planet of related significance to be in particular zodiac signs (considered as debilitated or enemy signs) for people when the corresponding life effect is undesired. We find from the chi-square test that the probabilities of such configurations are similar in both the groups for all the planets; hence, the principle is not valid.

Rule P4—Planet in Debilitated or Enemy Sign AND in Conjugation, Square, or Opposite to Saturn, Mars, Rahu, Ketu, or Uranus: This principle is nothing but simultaneous compliance with the previous two principles and is considered to produce a more malefic effect. Because the probability of complying with both conditions simultaneously is much less likely for any planet, the number of cases that comply with this principle comes down in both groups. When compared with each

Table 1: Results of Chi-square test run on "number of cases in Group A and Group B complying with various rules related to planets"

Rule	Rule P1		Rule P2		Rule P3		Rule P4		Rule P5		Rule P6	
Planet	p value	Stat value	p value	Stat value	p value	Stat value	p value	Stat value	p value	Stat value	p value	Stat value
Sun	0.19	1.73	0.78	0.08	0.07	3.33	0.31	1.04	0.62	0.24	0.81	0.06
Moon	0.06	3.56	0.11	2.56	0.51	0.43	0.25	1.33	1.00	0.00	0.62	0.24
Mars	0.94	0.01	0.84	0.04	0.83	0.05	0.78	0.08	0.86	0.03	0.72	0.13
Mercury	0.15	2.09	0.95	0.00	0.26	1.25	0.93	0.01	0.34	0.91	0.26	1.25
Jupiter	0.70	0.15	0.55	0.36	0.95	0.00	0.84	0.04	0.91	0.01	0.09	2.92
Venus	0.41	0.68	0.74	0.11	0.28	1.19	0.58	0.31	0.93	0.01	0.09	2.80
Saturn	0.26	1.27	0.48	0.49	0.48	0.50	0.17	1.88	0.73	0.12	0.80	0.06
Rahu	0.09	2.95	0.11	2.56	0.37	0.81	0.57	0.32	0.43	0.62	1.00	0.00
Ketu	0.19	1.69	0.71	0.13	0.43	0.63	0.24	1.40	0.05	3.85	0.51	0.43

Null Hypothesis: The numbers of cases complying with the given rule are equal in both groups.

Conclusion: Null Hypothesis could not be rejected for any planet for compliance with any of the rules tested above because the p-value has been > 0.05 and Chi-square statistic value has been < 3.84 (critical value), in all cases.

other, however, they are not significantly different between the two groups. Therefore, the principles neither individually nor in combination act as a differentiator.

Rule P5—Planet in Conjugation with the Lord of the Sixth, Eighth, or Twelfth House: This principle is about the difference in degrees between the planet under test and planets that act as lords of the sixth, eighth, or twelfth house in the birth chart. If the difference is ±4 degrees, then the rule is considered as complied with. If this principle is valid, it should have been reflected in the results for at least one planet, but we did not find this.

Rule P6—Planet in Malefic Nakshatra, Namely Krittika, Ashelsha, or Mul: In this principle, we are again checking the probability of degrees of the planet being in a range that correlates to above nakshatras (Rao 2004). The Moon and Mercury in these nakshatras are considered especially malefic from the fortune and intelligence perspective, respectively. As can be seen from the results, however, there is no significant difference in the number of cases in both groups, not only for these two planets but for all of the others; hence, the rule is proven invalid. Quite often astrologers suggest remedies for people because the Moon appears in these nakshatras. This is plainly unjustified, because the principle itself is invalid.

These results pose many questions about the predictions made using these principles in general, because these principles act as the basic premise of astrology. Considering the importance of Mercury, the Moon, and Jupiter in astrological predictions—especially for intelligence (Raman 1996; Rao 2004; Rath 2012)—the above results show that their significance to intelligence is not proven.

We must add that besides testing these principles for all planets, we also have tested them in a similar manner for the planets said to act as lords of individual houses. Indian astrology asserts that like every planet, the lords of the houses also contribute to predictions. The lord of the house is nothing but a ruler planet of the zodiac sign of the house (Raman 1996; Rao 2004). Depending on the ascending sign, the zodiac signs of the houses are different. In our experiment, when two groups were compared, we did not find any difference in compliance with the rules by the lords of the houses. As an example, astrology expects that the lord of the first house complies with the above negative rules with more probability in Group B than Group A. Empirically, though, this has proven true for neither the lord of the first house nor for the lords of other houses. We are not giving the details here to avoid repetition, but that certainly poses questions around the fundamental rules for the lords of houses.

Principles Applicable for Houses

In Indian astrology, the houses, like the planets, are considered to affect people's lives, according to the significance attached to them (Rao 2004; Rath 2012). Regardless of which house has significance for intelligence, we tested the two most fundamental rules for all twelve houses to see if they showed up in our experiment for at least one house. Astrologers assume both principles give malefic, or undesired, effects. If this hypothesis is indeed valid, we expected them to affect more cases in Group B for at least one of the twelve houses. The principles and their results are presented below and in the Table 2.

Rule H1—Saturn and Mars Are Placed in the House, in the Opposite House, Have Third/Tenth Aspect of Saturn, or Fourth/Eighth Aspect of Mars: This principle anticipates a certain placement of Saturn and Mars with respect to the house under test with more probability in the case of Group B. As can be seen from the chi-square test, none of these twelve houses in Group B show any more chance of such configurations as compared to Group A. We therefore do not find merit in this principle.

Rule H2—Lord of the Sixth, Eighth, or Twelfth House Placed in the House: The consideration here from astrologists' point of view is that the planets that act as lords of the sixth, eighth, and twelfth house play an evil role in the birth chart. When they get placed in the house, they contribute to the destruction of the effect associated with the house. The results show that these planets do not get placed in any particular house with a higher probability in birth charts of Group B as versus Group A. The principle around their placements is therefore not found to be valid.

Just as we have seen principles for malefic effects that we have referred to as negative principles, there are principles for benefic (beneficial) effects too. In this article, we are referring to them as positive principles. These positive principles are generally defined in exactly the opposite manner as the negative principles from astrologists' perspective. For example, the positive principle opposite to those above will predict greater intelligence (beneficial effect) if the planet is in exalted or friendly signs rather than debilitated and enemy signs. For the sake of completeness, we tested positive principles opposite to the rules above and did not find any significantly higher compliance of these positive principles in Group A than Group B.

To take our investigation further, we also computed the total number of negative rules complied with by each planet for all the birth charts and took the average for Group A and Group B. From the astrologists' point of view, one would obviously expect a greater number of negative rules being complied with in Group B on average. Most astrologers, including those who participated in the double-blind tests, use this approach to predict undesired or negative effects. While analyzing the birth chart, they count the number of negative rules that are complied with by significant entities and compare that with the threshold value that is established based on their past experiences. When tested for each planet through two sample T tests of significance (Table 3), however, we did not find any significant difference in the average number of rules complied with in Group B as opposed to Group A.

It is important to understand, therefore, that the prediction of adverse effects based on greater compliance with negative rules is erroneous. This is because empirically, both groups have the same compliance on average, even though the individual values (for given birth charts) do vary around the mean value within the range of standard deviation for both groups. We can take the example where the number of negative rules complied with by Mercury is three in a given birth chart. Assuming that this predicts adverse effects related to the significance of Mercury because it exceeds 1.75 (the Group B mean) is incorrect. This is because the number of rules complied with varies from zero to five for both groups. If we account for the number of cases where compliance is greater than three in both groups, they will not be significantly different. Hence, it is incorrect to predict based on total number of negative rules complied with. Along similar lines, we calculated the total number of positive rules complied with by the planets and found that their averages were also not significantly different among the two groups. Thus, the total number of positive rules complied with can also not be the criterion for predicting positive effects.

Despite this extensive testing, there will always be arguments about which additional rules should have been tested. While more principles can always be tested, there should be a logical explanation for why none of the sixteen principles we tested for the thirty-four entities in our comprehensive test showed any difference; they would be expected to be substantially different from an astrological perspective. Also, we cannot ignore the fact that what we have tested and found invalid is the inherent and core part of Indian astrology. It is being used in day-to-day practice by astrologers. One can only imagine the risk to society by allowing decisions to be made based on astrology.

These results explain why in double-blind tests of astrology in general—and in the 2008 test by Narlikar et al. in particular—none of the astrologers could hit a better success rate than 50 percent. In our view, though astrologers have their own sets of rules used for predictions, the rules are mostly

Table 2: Results of Chi-square test run on "number of cases complying with rules related to houses in Group A and Group B."

	Rule H1		Rule H2	
House tested	Chi-square P value	Chi-square statistic	Chi-square P value	Chi-square statistic
House 1	1.00	0.00	0.48	0.49
House 2	0.75	0.10	0.93	0.01
House 3	0.96	0.00	0.45	0.56
House 4	0.84	0.04	0.15	2.03
House 5	0.08	3.10	0.05	3.69
House 6	0.46	0.54	0.17	1.86
House 7	0.38	0.78	0.93	0.01
House 8	0.76	0.09	0.19	1.73
House 9	1.00	0.00	0.31	1.01
House 10	0.45	0.57	0.10	2.74
House 11	0.92	0.01	0.16	1.97
House 12	0.96	0.00	0.59	0.29

NULL Hypothesis: The numbers of cases complying with the given rule are equal in both the groups.

Conclusion: Null Hypothesis could not be rejected for any of the houses we tested as p-value has been > 0.05 for all the rules and Chi-square statistic value is < 3.84 (critical value) in all cases.

Table 3: Results of two sample T tests on the average number of negative rules complied with by each planet in Group A and Group B

Planet	Avg. no. of negative rules complied with in Group A	Avg. no. of negative rules complied with in Group B	p value of T test
Sun	1.50	1.64	0.11
Moon	1.66	1.74	0.40
Mars	1.17	1.21	0.62
Mercury	1.63	1.75	0.24
Jupiter	1.44	1.37	0.38
Venus	1.55	1.59	0.69
Saturn	1.44	1.38	0.49
Rahu	1.26	1.26	0.97
Ketu	0.94	0.99	0.48

Null Hypothesis: Average number of negative rules complied with by the planet in both groups are equal.

Conclusion: We cannot reject the Null Hypothesis as the p-value of each planet has always been > 0.05. The average number of negative rules complied to by the planet can thus not act as a differentiating factor.

based on the fundamental principles tested above. These principles do not act as a differentiator themselves, nor do they produce a differential negativity when they are summed up together. Hence, no one could achieve a success rate better than random chance. It is thus the limitation of astrology, and not of the astrologers, that astrology failed. ■

Acknowledgment

We thank Dr. Jayant Narlikar for the discussions and guidance he provided for this research. His input has added a great value to the paper. We are also grateful to him for having been the architect of the double-blind experiment carried out in 2008 that forms the basis of our test. The late Dr. Narendra Dabholkar and the late Dr. Sudhakar Kunte were also part of this experiment, and we express our sincere gratitude for their contributions. We are grateful to volunteers of Andha Shradha Nirmulan Samiti (ANS), who collected the birth details of several hundred students over a period of a few months. This was a huge effort and forms a vital component of our work. We also sincerely thank the parents and teachers of the mentally challenged students in this study for their understanding and support.

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The Prince of Alternative Medicine

Harriet Hall

Charles, the Alternative Prince: An Unauthorized Biography. By Edzard Ernst. Exeter, United Kingdom: Imprint Academic (Societas), 2022. ISBN 978-1788360708. 210 pp. Softcover, $29.90; kindle, $15.99.

It's common knowledge that Prince Charles is a persistent and outspoken champion of alternative medicine, but the full story has never been told—until now. Edzard Ernst reveals all the shocking details in this unauthorized biography. The shocks come from Charles's own words, which Ernst quotes extensively.

It is ironic that Charles's supporters were responsible for getting Ernst's research funds withdrawn and forcing him into early retirement. Ernst has done more than anyone else in the world to investigate alternative medicine, trying to ferret out which treatments are effective and safe. He once practiced homeopathy and was enthusiastic about alternative medicine, but as new evidence emerged, he changed his mind; Charles did not. As the first professor of complementary medicine, for two decades Ernst led an incredibly prolific multidisciplinary team of twenty researchers. They published over 700 papers in scientific journals, with many systematic reviews of the existing evidence. They also published research papers on various alternative modalities; in a box at the end of chapter 2, Ernst lists thirty-eight they investigated. These included the ABCs of acupuncture: Bach flower remedies and chiropractic on down the alphabet through exercise, moxibustion, reflexology, and yoga.

Charles had been peripherally involved in establishing Ernst's position at the University of Exeter. He has repeatedly called for more research, but he doesn't want the kind of research Ernst does. Charles envisions research that will find evidence to provide scientific support for alternative medicine.

* * *

As a young man, Charles embarked on a private voyage of spiritual inquiry. He was intuitively averse to scientific materialism and drawn to mysticism. He fell under the spell of Laurens van der Post, who introduced him to the teachings of Carl Jung and the idea of the collective unconscious. Van der Post interpreted Charles's dreams and urged him to give up all his duties and withdraw from the world to seek an "inner world truth." Charles repeatedly sought his advice and made him a godfather to Prince William. After his death, van der Post was shown to have been a compulsive fantasist who constantly lied about everything, including every detail of his fictitious personal history. It was revealed that he had seduced, impregnated, and then abandoned a fourteen-year-old girl. Charles has never commented on these disclosures; in fact, he doesn't even mention van der Post in his book *Harmony*, in which he explains his underlying philosophy.

Ernst quotes the ever-eloquent Christopher Hitchens: "We have known for a long time that Prince Charles's empty sails are so rigged as to be swelled by any passing waft or breeze of crankiness and cant." Charles has chosen to surround himself with unscrupulous people and listen to bad advice unquestioningly. The finance director of the Foundation for Integrated Health (FIH), a charity founded by Prince Charles, was given a three-year sentence for siphoning off £253,000 of FIH's funds; the FIH was later closed. Shortly after his thirty-fourth birthday, Prince Charles was elected president of the British Medical Association and asked to address that august body. They were surprised when he went on a full-frontal attack, saying science had become estranged from nature. He accused them of unfairly rejecting anything unorthodox or unconventional, of failing to address the whole patient, and of ignoring traditional wisdom.

You can guess their reaction. Ernst quotes from a biography written by Tom Bower:

> For a thirty-four-year-old with a mediocre degree in history to preach the power of spiritualism, based on a jumble of ideas inherited from van der Post, Jung, and … Paracelsus … to an audience of doctors, the science that produced the drugs that had eradicated polio and tuberculosis, was as frightening as it was brazen.

This pattern of behavior was repeated many times. Ernst quotes Charles's open letter to *The Times* and his lecture to the World Health Organization (WHO) in their entirety, with

the addition of lists of his own specific comments debunking what Charles said.

Charles repeatedly interfered in politics, writing to politicians and to the Health Secretary, lobbying for the National Health Service (NHS) to fund alternative medicine. After a protracted legal battle, some of Charles's private letters and memos were disclosed to the public over the objections of the palace. Ernst points out numerous false statements in that correspondence, including the assumption that it would reduce costs. He rightly points out that there cannot be *cost-effectiveness* without *effectiveness*.

Charles misrepresents conventional medicine as limited to "pills and procedures" and "focusing on symptoms alone." Ernst points out that conventional medicine includes care, compassion, dialogue, empathy, and concern for the welfare of the whole person. Adding unproven treatments would only make conventional medicine more imperfect. Overuse of antibiotics has endangered our health, but homeopathy is not the solution to that problem.

Charles claims he wants research, but his idea of research is to validate his beliefs about alternative treatments—not to investigate whether they are effective and safe. In one biography, Charles was quoted as saying, "the evidence of experience is just as important as scientific evidence." In his experience, a cow got better after homeopathic treatment, so he assumed the treatment caused the improvement. That's a classic *post hoc ergo propter hoc* fallacy. Experience never amounts to reliable evidence, because it doesn't tell us what might have happened without the treatment. It doesn't take into account factors such as the natural history of the condition, regression to the mean, the placebo effect, and concomitant treatments. As Mark Crislip said, the words "in my experience" are the three most dangerous words in medicine. Evidence without a control group is no more reliable than an untrustworthy anecdote.

Ernst asks whether Charles is really ignorant about science or if this is just "motivated ignorance," a lack of knowledge due to a conscious decision to ignore information that he perceives as inconvenient, disturbing, or unwelcome. Ernst says "Today, the Enlightenment is celebrated as a symbol for rational thinking and scientific analysis." Charles is intuitively poised against reason and science. When accused of being the enemy of the Enlightenment, he said, "I felt proud of that." Charles acts on his intuitions and beliefs. Ernst says he is welcome to his own opinions but not to his own facts. When he talks about architecture, he is expressing his opinion. When he pretends his opinions about alternative medicine amount to evidence and interferes with healthcare, he stands in the way of progress.

Credit: Jamie Roach / Shutterstock

Ernst calls Charles's passion for homeopathy "the best example for showcasing the failure of his promotional activities." The number of homeopathic hospitals in the United Kingdom has dropped from five to zero, and the NHS is no longer reimbursing the costs of homeopathy. Charles managed to get chiropractic and osteopathy regulated by statute; he was unable to do the same for homeopathy. He believes homeopathy is harmless and has been scientifically proven to work; both ideas are demonstrably untrue.

Each chapter of the book ends with a box of information points. The box for the chapter on homeopathy made me laugh; it is a list of forty examples of homeopathic remedies that are not based on any material at all, including essence of Milky Way, emanations from Stonehenge, vacuum, wind, and the color blue! I thought the homeopathic remedy Berlin Wall was ridiculous, but these examples take the cake.

In chapters on specific alternative modalities such as chiropractic, osteopathy, and homeopathy, Ernst first states Charles's views then covers the evidence and describes the consequences. For instance, Charles's support led to statutory regulation of chiropractic, but chiropractors published very little research, there were widespread failures to comply with the General Chiropractic Council's own standards, and they failed to establish a monitoring system for adverse effects of spinal manipulation.

Ernst calls Charles's book *Harmony* "a lasting document of his often-bizarre views," demonstrating that he is ill-informed, ill-advised, and often

dangerously wrong. Charles claims acupuncture is a proven discipline, and he endorses osteopathy, homeopathy, and Ayurvedic medicine. He also endorses several diagnostic methods that have been tested and shown useless. He claims that pulse and tongue diagnosis, foot reflexology, and iridology are based on thousands of years of ancient wisdom and are immensely valuable. *Ancient?* I don't doubt that people have been massaging aching feet for eons, but modern foot reflexology is a twentieth-century invention. And wasn't iridology invented by the nineteenth-century Hungarian physician Ignaz von Peczely based on his observations of an owl?

Charles became an alternative medicine entrepreneur when he launched his Duchy Originals Detox Tincture in 2008. It was a mixture of globe artichoke and dandelion extracts that promised to remove toxins and aid digestion. The company falsely claimed it had been tested for efficacy when in fact it had been tested only for safety and quality. It was quickly censured by the UK Advertising Standards Authority for violating advertising rules, and it provoked international criticism and ridicule. Ernst wrote that the idea of detox flies in the face of science; he called it implausible, unproven, and dangerous. Steven Novella called it snake oil and an old con. The British Dietetic Association chimed in to say the idea of detox was a load of nonsense. The product was withdrawn from the market. It was not only a financial failure but also damaged Charles's reputation.

One might think Edzard Ernst would hate Prince Charles for his role in getting funding withdrawn from Exeter University. Did he write this book to get revenge? I don't think so. There is no hint of personal animosity in this book. And Ernst is not prejudiced against alternative medicine *per se*. He only asks that all claims for efficacy be based on credible evidence, regardless of whether they are alternative or mainstream.

In the foreword, Nick Ross says he believes Prince Charles is a fundamentally good human being, and his motives are right even when he is wrong. Ross characterizes the controversy as "a contest between honest belief and honest evidence." In the last chapter, "Final Thoughts," Ernst says he still believes that alternative medicine has a few hidden gems to discover. But to find them, we need good science and people with influence to support research:

> Charles could so easily have been that person. Instead, he took consistently poor advice and chose to follow a different path. He pursued a largely anti-science agenda and promoted the uncritical integration of unproven treatments into the NHS … he became an obstacle to progress in healthcare and generated more harm than good. My predominant feeling about that is sadness over a missed opportunity.

I can recommend this book wholeheartedly. It should be interesting reading for anyone who wants to learn more about science, skepticism, and critical thinking. It tells the whole story of Prince Charles's ignorance and folly matter-of-factly, relying mostly on Charles's own words. It is clear, well-written, and divided into easily digestible short chapters. It emphasizes the principles of good science and why science is superior to intuition as a way of finding out the truth. My only complaint is the typos that the publisher's proofreaders missed. My favorite was "heir to the thrown." It made me wonder if Queen Elizabeth had ever been thrown in a wrestling match; I think that's unlikely! ■

Harriet Hall, MD, often called "the SkepDoc," is a contributor to *Science-Based Medicine* and a contributing editor and columnist for the Skeptical Inquirer.

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A Skeptical Look Down *Nightmare Alley*

MARK EDWARD

Guillermo del Toro's *Nightmare Alley* isn't just a film experience; it's a tutorial in the practices and techniques of the psychic marketplace we live in and a dark reflection of the world we have come to accept as normal. We can no longer deny lying has become a successful business practice, and del Toro has created a lasting document showing how it's done by the pros.

When William Lindsay Gresham's original novel was published in 1946, it gave a seminal peek behind the curtain at the manipulations that magicians put to good use at the time. It also poked a sharp stick at the lower depths of sideshow denizens, carny hustlers, and spirit mediums who plied their trades without resistance. After all, this was during a time when war and poverty gave society no better people to listen to their bereavements and woes than such sociopaths and losers.

The treasure trove of actual "psychic secrets" that gets tipped throughout *Nightmare Alley*'s 150-minute running time is invaluable. Every skeptic needs to see this film, and you won't be disappointed.

Early in my magic career, I realized that for so-called "psychic entertainers"—or those of us who were veering away from card tricks and being drawn into the New Age carnival pitch that was the Uri Geller style of those times—*Nightmare Alley* became a sort of rite of passage. If you ran into a fellow mentalist who hadn't read it (or seen the 1947 filmed version), it was best to mention it, gauge the reaction, and in so doing know immediately how high or low this person was willing to go entertainment-wise. When you don't accept you are a mortal and refuse to fall off your psychic high horse, you are termed a "shuteye" in the parlance of the carny.

Nightmare Alley. Directed by Guillermo del Toro. Based on the novel by William Lindsay Gresham. Starring Bradley Cooper, Cate Blanchett, Toni Collette, Willem Defoe, and Ron Perlman.

It's a well-known term used "on the inside" for someone who is a believer.

The scene in both *Alley* films in which Stan (the protagonist, played by Bradley Cooper in the new film) gives an impromptu reading "like a father to a son" to the town sheriff who has arrived to close down the carnival is pivotal. You can learn a lot from just that one scene. There's a line from the book showing the tightrope walk an ethical mentalist or psychic has to learn to balance in his or her mind: "How the hell shall I finish this off, Stan wondered. I can talk myself right back into the soup if I don't quit."

The characters all know what they are doing and carry on down the alley anyway, some more criminally than others. It's almost as if the subtext of both films is telling us that, well, *everyone believes a little bit, so why not use it?* This is part of why the story is so compelling. The characters are well fleshed out. If you like your femmes fatale, I think I can safely say Cate Blanchett as Lilith Ritter, the devious psychoanalyst, sets a new record for noir smoldering in her role. She's terrific.

We are looking at a social comment that has lain simmering in the psychic cauldron for decades. We can thank Guillermo del Toro for dragging out the old cons and dodges to not-so-subtly imply how much worse it can be today. I seriously doubt back in the 1940s any town sheriff or concerned citizen would allow the sort of unscrupulous tactics today's psychics boldly use, such as holding psychic Zoom circles for kids five to twelve years old, infiltrating grief groups to get at the bereaved, pestering the parents of missing or murdered children, or using social media to mine for information on their marks. We see how Stan uses traditional methods for getting personal information. These time-honored techniques are still widely used today.

It's easy if you can roll that way. As I heard from some wag years ago, it's all about sincerity: Once you can fake that, you've got it made. It's not pretty or glamorous—and neither is the price we may hope gets eventually paid by these scheming grifters. Unfortunately, in our world, there are thousands of Stanton Carlyles and Lilith Ritters putting their own brand of fraud out there who go on day after day, week after week, year after year pulling the same cons we see in *Nightmare Alley* over and over.

Thank you, Guillermo del Toro and writers Kim Morgan and William Lindsay Gresham, for finally telling it like it really is. ■

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Breaking News, My Foot!

How Cable TV Has Changed the Standard

BRYAN FARHA

This is not a commentary about false news, fake news, misinformation, or disinformation. That's for another day. This is about how television news alerts have changed over the years—mostly thanks to cable TV—even if the content is accurate.

A Google search for "TV breaking news definition" yields the Wikipedia result first, which reads, in part: "a current issue that broadcasters feel warrants the interruption of scheduled programming or current news in order to report its details." In other words, these news alerts (e.g., newsflashes or special reports) are of sufficient magnitude that they justify interrupting current programming. Big news items. *Really* big. And that's the standard established decades ago, before cable TV, when the "big three" network television outlets (NBC, ABC, CBS) were the staple of the airwaves. That high standard is mostly still intact for the big three. For one of the networks to air a breaking news story about Britney Spears—unrelated to a life-or-death situation—is unimaginable.

Prominent cable television news outlets—CNN, MSNBC, and FOX, for example—have changed or even watered down breaking news to such a degree that it's hard to take it seriously anymore unless it matches the magnitude of such alerts from yesteryear. Speaking of which, some historical examples of justifiable breaking news from the big three networks decades ago include the President Kennedy assassination, the Apollo 11 moon landing, and the killing of Martin Luther King Jr. People would literally stop what they were doing, gather around the television, and fully focus on the breaking story because of its magnitude—clearly worthy of interrupting programming. Occurrences of such gravity are indelibly tattooed in the deepest recesses of peoples' memories (for those who were around for them). Psychologists term these "flashbulb memories."

There is no doubt that cable TV overuses breaking news to increase viewership in the hopes of gaining a competitive edge—and no doubt political agendas often influence news alerts. That said, here are some of the properties of big three, network breaking news from decades past and how things have changed, especially concerning contemporary cable television:

• **Sufficient Magnitude**: Previously discussed regarding the big three networks from the old days. Cable TV, however, has watered this down so much that it is sometimes unrecognizable as breaking news. For example, an hour or so before an event (I don't recall the specific event it was leading up to, but it was likely a significant speech such as a State of the Union address—which is clearly of sufficient magnitude), the CNN breaking news banner read, "PRESIDENT TRUMP IS IN THE BUILDING." This is not breaking news; it's barely news at all. Who cares if he's in the building? And this example has nothing to do with a political bias on the part of this author. The reason it resonated is because it happened years prior when the same network's breaking news banner read "PRESIDENT OBAMA IS IN THE BUILDING." Exactly the same. Insufficient magnitude. And it's not just CNN. Cable TV networks regularly contort mundane facts into breaking news stories.

• **Event-Based:** Examples in the opening paragraph, such as the Apollo moon landing, were about specific *events*. Today, we see breaking news regarding comments as well. Sure, the comments (although not events in and of themselves) are likely *related* to events, but comments should rarely warrant breaking news; however, it happens regularly on cable television. For example, CNN opened the December 2, 2021, 8 p.m. CST broadcast with breaking news about an Alec Baldwin comment regarding the deadly movie set shooting, "I DIDN'T PULL THE TRIGGER." Of course this is an important story, but it's not true breaking news. Rather, it's one important comment from a lengthy interview that was morphed into breaking news.

• **Simultaneous Network Alerts**: Both now and in the past, if there were a special report on a big three network, understandably all three had it—and concurrently. If a television viewer encountered breaking news on CBS, then ABC and NBC would have it as well at the same time—evidence that it justified the term "breaking news." But with cable TV these days, one network can have a breaking story but not the others. On November 29, 2021, MSNBC opened the 5 p.m. CST newscast with a breaking story

"U.S. BARS TRAVELERS FROM 8 COUNTRIES WITH NEW VARIANT." But there was no breaking story for FOX or CNN opening their broadcast that day in the same time slot, although they no doubt considered it an important story. In fact, we sometimes see different breaking stories on different cable networks at the same time. On December 2 at 8 p.m. CST, while CNN was airing the Alec Baldwin "breaking" comment, FOX opened with the breaking news that "BIDEN FALSELY CLAIMS HE MET ISRAELI PRIME MINISTER GOLDA MEIR DURING THE SIX-DAY WAR." Frankly, neither seems like a genuine breaking news story, but we have to keep in mind that many primetime (evening) cable news broadcasts are classified as "commentary" rather than "news."

• **Broadcast Interruption:** Before cable television, breaking news would interrupt regular programming or a commercial. But we rarely, if ever, see a cable news network interrupting a commercial for breaking news like the big three did (and still do). It's become so watered down that cable anchors often announce there will be breaking news after the commercial. If the story justifies "breaking news," doesn't it justify delaying the commercial?

* * *

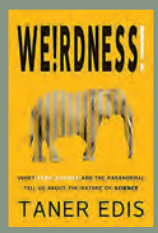
Breaking news is often so watered down and has so diminishing an effect that the viewer is faced with judging its worthiness. We do see legitimate breaking news on FOX, MSNBC, and CNN, concurrently, such as the Omicron COVID-19 variant alert on these networks (opening their respective 10 a.m. CST broadcasts of November 26, 2021). But the degree to which "breaking news" is overused or watered down makes it difficult to take seriously. It's almost not worth watching if the TV screen doesn't include the breaking news banner. Breaking news, my foot! ■

Bryan Farha is professor and director of applied behavioral studies graduate programs at Oklahoma City University and editor of *Pseudoscience and Deception: The Smoke and Mirrors of Paranormal Claims*.

NEW AND NOTABLE BOOKS]

Listing does not preclude future review.

THE CONJUROR'S CONUNDRUM: My Life in Magic and Skepticism. Jamy Ian Swiss. Swiss, a professional magician and longtime book reviewer for *Genii* magazine, has been active in the skeptical movement for nearly forty years. The title of his new book comes from the seeming paradox that many magicians (e.g., Houdini, James "The Amazing" Randi, Banachek, Ray Hyman, and Richard Wiseman) become activists who dedicate themselves to protecting the public from deception. The book is handsomely produced, square shaped, and has gold foil lettering. The book is divided into two parts: "Beginnings: Becoming an Honest Liar" (the latter phrase the title of the award-winning 2014 documentary about Randi) and "Continuings: My Life in Skepticism." Swiss takes readers on a brisk and engaging tour of the rise of both Spiritualism and skepticism, focusing on men of science who were fooled by psychic mediums—and the magicians who offered insight into how the tricks were done. The Amazing Randi and his Million Dollar Challenge are discussed, and the book ends with a look at modern claimants and how magic and skepticism continue to expose them. Along the way, Swiss offers many anecdotes, from his boyhood visit to the World's Fair that sparked his skepticism to meeting—and later working closely with—Randi. In a section titled "Stories from the Trenches," Swiss takes the reader through some of the vagaries (and occasional indignities) of being a skeptical spokesperson, many of which ring all too familiar. Swiss saves special venom for magicians, such as Kreskin, who exploit ambiguity and play both sides of the fence. Kreskin implies he has special powers (or not) depending on his audience and where he can make a buck. There are many—though not enough—books on skepticism from various approaches. However, there are notably few memoirs about skepticism per se. If *The Conjuror's Conundrum* sometimes comes off as brash, brilliant, and opinionated, well, that's Swiss coming through loud and clear. An index would have been nice, but the book does offer a small bibliography. Overall it's a fun, educational, and passionate read. Available at jamyianswiss.com, 2021, 158 pp, $25.



WEIRDNESS! What Fake Science and the Paranormal Tell Us about the Nature of Science. Taner Edis. Physics professor Edis teaches a university course titled "Weird Science," in which his students discuss and debate the nature of dubious (and seemingly mysterious) phenomena—of the type that fill these pages. Here, over the course of six chapters (including "Beyond the Evidence," "Gods and Demons," "Knowledge and Meaning," and "Reasons to Believe"), Edis reflects on what he's learned from the class and how it applies more broadly. He notes that "Popular weird beliefs can be an easy target: Do we really want to train our big critical guns on Bigfoot? Our best reason to do so might be if Bigfoot is a training exercise. What students learn while debating Bigfoot might help them better analyze other weird claims. And why stop with what is obviously weird? If the students get better acquainted with intellectual mistakes, they might be better equipped to notice intellectual pathologies cloaked in respectability—hiding, perhaps, in their own disciplines." *Weirdness!* is as unapologetically idiosyncratic as Edis—from his physics-related t-shirts he likes to wear to politics in his native Turkey to the sign outside his office door at Truman State University identifying the contents within as "Physics and Weirdness." It is also broad in scope, touching on epistemology, academia, religion, philosophy, creationism, overlapping magisteria, and more with a focus on the erosion of trust in scientific institutions. Pitchstone Publishing, 2021, 280 pp., $16.95

— Benjamin Radford

Skeptical Inquirer
THE MAGAZINE FOR SCIENCE AND REASON
From Russia's Stalin to Climate Change—
The Irrational World of Motivated Reasoning
Teach Skills, Not Facts
Honing Your BS Detector
SETI and Skepticism
Satanic Panic Update
SPECIAL REPORT: Take Sodom Meteor Strike Claims with a Pillar of Salt

Dissonance and Reasoning

I enjoyed reading David Robert Grimes's article concerning motivated reasoning ("Schrödinger's Bin Laden: The Irrational World of Motivated Reasoning," January/February 2022). The background discussion of Dr. Festinger's origin of the cognitive dissonance (CD) theory, along with the admission toward the end of the article that CD is sometimes selective, affirms my long-held position that CD doesn't exist. I say that because I've never seen dissonance. People are not bothered in the least by maintaining two different compartments of thought. These conflicting thoughts are not the cause of discomfort, because people don't examine the two thoughts against each other.

Frequently, I must explain to folks that their thoughts are in conflict. I see them think for a moment and often say, "I never thought about that." People are not the rational, thoughtful creatures that Festinger assumed. People pretend. Just like children playing a game that they know is fantasy, adults do the same thing. Why assume that hitting the ripe age of adulthood makes people rational? Adults are just opinionated children.

People tell themselves stories about who they are. Their personal identities depend on believing these stories. To change one would be like committing suicide. This alone can explain why people believe false stories. If people were the rational machines Festinger assumed, then not only would they abandon the fantastic stories of their religions, but these religions would never have gained any traction.

Tom Shoemaker
Eustis, Florida

It seems to me that Grimes is wandering past the point when he uses the phrase "motivated reasoning." His article comes close to congratulating those of us who are rational in our thinking. The fact is most people are pretty good reasoners. They know how to get from a premise to a conclusion. It's the premises that they work with that are the problem (or not if we happen to agree with them).

All reasoning is motivated. We use reason to achieve some goal. It could be the solution to a practical problem (how to bridge a creek) or to solve a puzzle (why do frogs croak?) or to achieve some sense of meaning or purpose (what should I do with my life?) or to help us choose (is it time to replace my aging car?).

And of course, we use reason to feel comfortable with a choice or belief. It seems to me that this is Grimes's actual subject. What he calls "motivated reasoning" is what my logic course taught me to call "rationalization."

The thing is reasoning cannot lead us beyond the premises that we reason with. It's a "garbage in, garbage out" process.

Wolf Kirchmeir
Blind River, Ontario,
Canada

Not Just the Facts

I thoroughly enjoyed Melanie Trecek-King's article "Teach Skills, Not Facts" (January/February 2022). I concur with her that all college students, both science and non-science majors, would benefit from a course teaching critical thinking and opinions based on evidence. Such a subject could also include such matters as illustrations of logical fallacies and the importance of properly interpreting statistics. I doubt, however, that many colleges would approve of mandating such a course because it would tend to controvert the underlying essentials of all major religions, based as they are on hearsay, myths, and unproven supernaturalism.

Henry R. Whitlock
Glen Rock, New Jersey

Melanie Trecek-King urges us to "teach skills, not facts" in non-major science courses, because "science is just good thinking." She describes her own redesign of a general biology course to focus on developing thinking skills.

Trecek-King is certainly correct that there is much bad thinking going around. Good courses on skill development are welcome but should be renamed. Science is not just good thinking; it also has essential content. Trecek-King recognizes this herself, because she begins by referring to the subject of the course she has now renounced as comprising "concepts in biology: molecules, cells, genetics, organisms, and evolution." These concepts are pillars of biology, and they provide a rational framework for myriad facts. Students also need to study concepts.

Unfortunately, Trecek-King explodes her own case by evidencing success with a sidebar of student testimonials. Four glowing comments are given. Such a limited sample, chosen by a teacher determined to promote her methods, is evidence Trecek-King should have taught students to view with deep suspicion. Furthermore, there is no guarantee that students will remember what they've learned more in the new course than the old. Finally, one suspects that any success is a result more of Trecek-King's transition from a dispirited to an energized teacher than anything else.

Alfred Holtzer
St. Louis, Missouri

See also Melanie Trecek-King's subsequent SI cover article, "A Life Preserver for Staying Afloat in a Sea of Misinformation" (March/April 2022). —Editor.

The SLAP Test

Thank you to Jeannie Banks Thomas for sharing her "SLAP test" as a way of evaluating rumors (January/February 2022). I would like to share a test I developed some years ago when I was working as a journalist. To evaluate the truth of a report or fact, I ask myself: "Who says so, and how do they know?" I have kept the habit lifelong. To me it is the basic question to ask about things you read or hear.

"Who says so?" refers to the original source of the information, not the reporter who wrote about it or the person who told me about it. Where did they get their information? Who told them? This does not necessarily mean knowing the source's name, but it does mean that the source is identified, at least in some descriptive way. If a fact is merely asserted with no source cited, I don't give it much credence. It might be opinion or rumor.

"How do they know?" is crucial; it's about the source's situation regarding the material they are being quoted on. Are they in an insider position in that subject or area, someone who is likely to know? If so, I generally accept the information as reliable. Is the source a well-known or respected person but not especially familiar with the area they are quoted about? I look for another source. Is the source a "friend of a friend" (FOAF), as folklorist Jan Harold Brunvand used to say? I do my own research. Odds are the claim will be quickly debunked.

Melanie Nickel
San Diego, California

The Eachy 'Monster'

Charles Paxton's article "Creating a Monster: The Case of Eachy"

(January/February 2022) caused me some distress and dismay. Skeptical Inquirer is about promoting truth, honest research, and the use of facts. By publishing an article in which the author intentionally invents nonsense and sets out to deceive the gullible, SI has damaged an excellent reputation. You have endorsed fabrication of information and distortion of the truth. The author may have felt he was doing something clever and cute, but there are so many examples of disinformation around us that he surely did not need to create another one—with your support.

John Guy
Augusta, Michigan

Charles Paxton replies:

It is a reasonable criticism, I think. In my view, obviously the ends justified the means, but I can see that people's opinions may differ. Psychologists frequently deceive participants of their experimental role, albeit that is not on the public stage and the subjects do consent to participate.

I always intended to come clean about it. I just did not think it would last thirteen years! I can also assure you I am not involved in any other hoaxes or misinformation.

Coincidences Abound

Thanks to Mick West for a lucid explanation of how ideas of reference are easily explained by basic math ("*Jeopardy!* and Ideas of Reference," January/February 2022).

He hits the nail on the head by noting that the chances of seemingly amazing coincidences should be based not on just that one particular thing happening to one particular person at one particular time but rather something *like* that happening to *some* person at *some* time. And, given that understanding, the odds go from very low to very high.

More people increase the odds of success; indeed, "million-to-one coincidences happen eight times a day in New York City."

My own favorite example involves the card game bridge. Odds are 635,013,559,600 to 1 that a particular combination of thirteen cards out of a fifty-two-card deck can appear in a bridge hand dealt to a single player. In combination with the same odds for the other three players, odds are 53,644,737,765,488,792,839,237,440,000 to 1 that each of their four hands could turn out in a particular way. Yet deal after deal, game after game, time after time, day after day, year after year, such "miracles" occur relentlessly.

The reason so much eyebrow-raising and wonderment occurs at normal coincidences is that most people don't have a very good understanding of statistics and probability.

We could use a good term to describe the condition that leads to their looking for ethereal explanations for ordinary phenomena. *Innumeracy* (lacking basic knowledge of mathematics and arithmetic) doesn't capture it, because it afflicts even people who are perfectly capable of computing mileage and balancing checkbooks. I suggest *astatisticia*.

Richard S. Russell
Madison, Wisconsin

Mr. West stated that *Jeopardy!* has 120 clues per game. However, the board is a six by five grid that equals thirty clues. So, thirty clues in *Jeopardy!*, thirty clues in Double *Jeopardy!,* plus one clue in Final *Jeopardy!* equals sixty-one total clues per game.

But 120 or 61, I watch every night but average only about 50 percent correct answers, so I guess *Wheel of Fortune* is more my speed.

Paul Giglia
Berea, Ohio

Mick West replies:

My mistake. I meant 120 clues plus answers. Clues and answers are essentially different "things," and then there are sometimes multiple things within a clue.

Gender Identity

I very much appreciated Peter Huston's book review of Debra Soh's, *The End of Gender* (January/February 2022). As a psychologist, I had read a few publications addressing whether gender is "binary" and related topics. I was starting to wonder whether science was leading current trends in thinking or whether current trends in thinking were leading science. I had been waiting to find an author whose work on these matters I could consider reasonably objective.

As I read Soh's book, I felt I was getting a relatively unbiased view, and I learned about relevant research as well as the social and political lay of the land in this area of scholarship. I noted, as did Huston, that Soh discusses her social affiliation with various groups, and she also wrote about her own personality, as well as harassment that legitimate researchers can face. Does she spend too much time on these issues? At first, I thought she did; I ultimately concluded that the book is not just an exposition of current scientific evidence but is also a story about maintaining independent mindedness in the face of social pressures, sticking with the scientific evidence, and limiting bias by entertaining alternative hypotheses and seeing what fits the evidence. It is an account of science and skepticism in action. Both the book review and the book were excellent.

Andrew D. Reisner, PsyD
Psychologist
Cambridge, Ohio

The skeptics community prides itself as a bulwark against pseudoscience and social panics, and so it is disturbing to see in it a trend toward embracing anti-transgender rhetoric that encompasses both. A case in point is Peter Huston's positive review of Debra Soh's *The End of Gender*. Soh is known for promoting debunked and discredited "science" on gender, such as AGP and ROGD, and supports the practice of conversion therapy, which is opposed by psychiatric organizations as ineffective and by human rights advocates as harmful. Soh also encourages social panic, portraying transgender identity as a threat to women and children, a tactic that has long been used to dehumanize and persecute minority and LGBTQ populations.

When called out on their transphobia, writers such as Soh will complain that they are being "de-platformed" and "canceled" by "woke" ideologues, all while being promoted by authoritarian pundits and credulous media outlets who take as given their anti-transgender appeals to scientific rigor. Before writing on the subject of gender identity, I believe it is especially incumbent upon authors in this publication and others like it to do the appropriate research and consultation with medical experts regarding standards of care and outcomes for transgender youth and adults, the countervailing peer-reviewed science, and transgender and allied authors and journalists with direct knowledge of the affected communities.

Kassandra Sharp
Palo Alto, California

[FEEDBACK

The letters column is a forum on matters raised in previous issues.

Letters should be no longer than 225 words.

Due to the volume of letters we receive, not all can be published. Send letters as email text (not attachments) to letters@skepticalinquirer.org. In the subject line, provide your surname and informative identification, e.g.: "Smith Letter on Jones evolution article." Include your name and address at the end of the letter. You may also mail your letter to the editor to 944 Deer Dr. NE, Albuquerque, NM 87122.

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